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FRANCIS LORD BACON.

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THE

WORKS

OF

FRANCIS BACON,

BARON OF VERULAM,

VISCOUNT ST. ALBAN,

AND

LORD HIGH CHANCELLOR OF ENGLAND.

IN TEN VOLUMES.

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THE

LIFE OF FRANCIS BACON,

LORD HIGH CHANCELLOR OF ENGLAND.

THE ancient Egyptians had a law, which ordained, that the actions and characters of their dead should be solemnly canvassed before certain judges; in order to regulate what was due to their memory. No quality, however exalted; no abilities, however eminent; could exempt the possessors from this last and impartial trial. To ingenuous minds this was a powerful incentive, in the pursuit of virtue; and a strong restraint on the most abandoned, in their career of vice. Whoever undertakes to write the life of any person, deserving to be remembered by posterity, ought to look upon this law as prescribed to him. He is fairly to record the faults as well as the good qualities, the failings as well as the perfections, of the dead; with this great view, to warn and improve the living. For this reason, though I shall dwell with pleasure on the shining part of my lord Bacon's character, as a writer; I shall not dare either to conceal or palliate his blemishes, as a man. It equally concerns the public to be made acquainted with both.

Sir Nicholas Bacon was the first lord Keeper of the seals invested with all the dignity, and trusted with all the power, of a lord Chancellor. This high employment he held under queen Elizabeth

near twenty years: a minister considerably learned, of remarkable prudence and honesty; serving his country with the integrity of a good man, and preserving, through the whole course of his prosperity, that moderation and plainness of manners which adorn a great man. His second wife was a daughter of Sir Antony Cooke, who had been preceptor to Edward the sixth, and of whom historians have made honorable mention for his skill in the learned languages. Neither have they forgot to celebrate this lady on the same account. To the truth of which even an enemy bore testimony, while he reproached her with having translated, from the latin, bishop Jewel's Apology for the church of England.

Parsons the Jesuit.

Such were the parents of Francis Bacon, whose life I am writing. Of two sons, by this marriage, he was the youngest: and born at York-house, in the Strand, the twenty-second of January, 1561. As he had the good fortune to come into the world at a period of time when arts and sciences were esteemed and cultivated, by the great and powerful, almost in the same degree they are now neglected; so he brought with him a capacity for every kind of knowledge, useful and ornamental. An original genius, formed not to receive implicit notions of thinking and reasoning from what was admitted and taught before him; but to prescribe laws himself, in the empire of learning, to his own and succeeding ages.

1561.

He gave marks, very early, of a pregnant and happy disposition, far above his years. We are told that queen Elizabeth took a particular delight in trying him with questions; and received so much satisfaction from the good sense and manliness of his answers, that she was wont to call him, in mirth, her young lord keeper. One saying of his deserves to be remembered. The queen having asked him his age, while he was yet a boy; he answered readily, that he was just two years younger than her happy reign.

Of his education I know no particulars, till he was sent to study in the university of Cambridge,

under Doctor Whitgift, afterwards archbishop of Canterbury: and I find he was entered of Trinity college in his twelfth year. The progress he made was rapid and uncommon: for he had run through the whole circle of the liberal arts, as they were then taught, before he was sixteen. But what is far more surprising; he began, even then, to see through the emptiness and futility of the philosophy in vogue: and to conjecture, that useful knowledge must be raised on other foundations, and built up with other materials, than had been employed through a tract of many centuries backward. In this, his own genius, aided by a singular discernment, must have been his only preceptor. In matters of reasoning, the authority of Aristotle was still acknowledged infallible in the schools; as much as that of the pope, in affairs of religion, had lately been acknowledged there and every where else. And our author may be justly styled the first great reformer of philosophy. He had the prepossessions, the voluminous and useless reading, nay he had the vanity of men grown old in contrary opinions, to struggle with: yet he lived to see a considerable revolution on his side. Another age brought over the learned of all nations to his party. 16th of June 1573.

It may be justly wondered at, that the lord Keeper, a minister of great observation on men and things, should have sent his son to travel at the age of sixteen; as we find he did: for, by a letter from Sir Amias Powlet, then ambassador in France, it is certain that young Bacon was at Paris, and under his roof, in the year 1577. We need but look around us, to be convinced how little our youth of quality, who visit foreign countries about that age, are wont to profit either in taste, wisdom, or morals. But perhaps he discovered in his son a maturity of discretion and judgment beyond what is common to that early season of life. However that was, the ambassador conceived a very favourable opinion of Bacon; for he sent him over to the queen with a commission that required secrecy and dispatch: of

which he acquitted himself with applause, and then returned to finish his travels. The native bent of his mind, strongly turned to reflection and inquiry, suffered him not to stop short at the study of languages, but led him higher, to remark accurately on the customs and manners of those that spoke them; on the characters of their princes, and on the constitution of their several governments. In proof of this, there is still extant among his works, a paper of observations on the general state of Europe, written by him shortly after this time; as I have discovered by a circumstance mentioned in it*.

He was the youngest son, and seems to have been the favorite of his father; who had set apart a considerable sum of money to purchase an estate for him, in his absence. But before that kind intention could take effect, the lord Keeper died suddenly, by the following accident. He was under the hands of his barber, and, the weather being warmer than usual, had ordered a window before him to be thrown open. As he was become very corpulent, he presently fell asleep in the current of fresh air that was blowing in upon him; and awaked after some time distempered all over. Why, said he to the servant, did you suffer me to sleep thus exposed? The fellow replied, that he durst not presume to disturb him. Then said the lord Keeper, by your civility I lose my life; and so removed into his bed-chamber, where he died a few days after. Thus there remained to his youngest son only the small proportion of a sum, which was to be divided among five brothers.

The narrowness of his circumstances obliged him to think of some profession for a subsistence: and he applied himself, more through necessity, than choice, to the study of the common law. For that purpose, he placed himself in the society of Gray's Inn; where his superior talents rendered him the or-

* He says that Henry III. of France was then 30 years old: now that king began his reign in 1574, at the age of 24 years. So that Bacon was then nineteen.

nament of the house: as the gentleness and affability of his deportment won him the affection of all its members. In his profession, he quickly rose to so much eminence and reputation, that, at the age of twenty-eight years, he was named by Elizabeth her learned council extraordinary: a distinction which he needed no assistance from his father's merit with her to deserve. It was however next to impossible that so noble a genius, born to embrace the whole compass of science, should confine its researches within the narrow and perplexed study of precedents and authorities; a study hedged round with brambles and thorns, dark and barbarous in its beginnings, and rendered in its progress still more obscure, by the learned dulness of commentators and compilers: men, for the most part, of indefatigable industry, and of no spirit or discernment. Accordingly we find that in this interval he often gave full scope to his conceptions; surveying the whole state of learning, observing its defects, and imagining the proper methods to supply them. This he first attempted in a treatise which he intitled THE GREATEST BIRTH OF TIME; as appears from a letter written after his retirement, to father Fulgentio, the Venetian, in which he passes a kind of censure on the pompous and swelling title prefixed to it. Though the piece itself is lost, it appears to have been the first outlines of that amazing design, which he afterwards filled up and finished in his grand Instauration of the sciences. As there is not a more amusing, perhaps a more useful speculation, than that of tracing the history of the human mind, if I may so express myself, in its progression from truth to truth, and from discovery to discovery; the intelligent reader would doubtless have been pleased to see, in the tract I am speaking of, by what steps and gradations a spirit like Bacon's advanced in building up, for more than thirty years together, his new and universal theory. He thought himself born for the use of human kind: and, in the letter above mentioned, styles himself the servant of posterity.

These few hints for filling up this first part of our author's life, trivial and unsatisfactory as they may appear, I have yet been obliged to glean here and there in the rubbish of several collections, where they lay scattered, without order or connection. But I shall now no longer regard Bacon as a mere philosopher; as a man of speculation who conversed only with books and his own thoughts in the shade of retirement and leisure. The course of his fortunes produced him on the great theatre of the world, involved him in business, and complicated him with the most considerable persons of the age he lived in. He was honorably employed by one prince, and highly preferred under another. It will be therefore necessary, that this history may have its due extent and usefulness, to exhibit a general prospect of the two reigns in which Bacon flourished and fell, at least in their principal points of view. The characters of those with whom he had any connection will illustrate his, and shew it in a truer, as well as a fuller light.

I have yet another reason for enlarging this account beyond the ordinary limits. Our author's letters are written, many of them at least, on public occasions, and may be considered as the most authentic vouchers for several remarkable occurrences, in which he himself was an actor, and well acquainted with the secret motives on which others acted. But as those things are for the most part only hinted at, or no farther opened than to serve the present purpose of his letter; they will require to be developed at some length, and ranged into their proper places.

Elizabeth had a larger share of good sense and sound judgment, than is commonly to be met with among women; accompanied with a greatness of mind and steadiness of purpose that might do honor to the best of men. These her natural endowments received much, though severe, improvement from the dangers she was exposed to in the first part of her life. She grew up in a strict attention over her own actions, even over her looks and

words, from the rigor of her father's temper, and particularly from the jealous cruelty of her sister's administration: a short but memorable period of time! when England beheld, under a female reign, such instances of merciless rage, such scenes of horror, as had of old startled the Roman world, under a Nero and a Domitian. The dreadful genius of that superstition to which she had devoted herself, then exerted its spirit undisguised, in betraying, tormenting, butchering, by the ministry of inhuman priests and inquisitors, whoever would not profess what he could not possibly believe. If we may credit historians, they had even doomed Elizabeth herself to die: and she escaped, miraculously, not by the kindness, but the policy of Philip; himself a tyrant, the coolest and most determined of these latter ages.

At her accession to the throne, she found her revenues anticipated or exhausted; her kingdom, through the sanguinary madness of her predecessor, disjointed and broken of its vigor within; at the same time unsupported by allies and without consideration abroad. Her good sense led her to see, by the errors of her father and her sister, that she could expect to reign with security, only by deserving the confidence and gaining the love of the nation: and that in order thereto, she must propose to herself no other end of ruling but the happiness and honor of all her people. This system of policy, so simple in itself, so glorious in its consequences, and yet by princes so seldom pursued, she adhered to steadily, almost uniformly, through a long and triumphant reign; for this very reason triumphant!

The reformation of religion she attempted and effected, at a season when her power was unconfirmed, and in probable danger from intestine commotions. For revolutions in religion are apt to put the whole constitution of a society into ferment, even more strongly than alterations in government; as every individual is immediately and intimately actuated by what seems to him of highest and most last-

ing concern. She kept awake, and animated, with wonderful address, the divisions in Scotland, in France, in the Netherlands: and that with more justice on her part, than is usually observed by princes when they would do ill offices to their neighbours. The sovereigns of those countries, when they agreed in nothing else, were ever combined in a common enmity to her: at a time too when she had nothing to oppose against their pretensions, their conspiracies, their open attacks, but her own courage and the native strength of England alone. And yet, by helping forward the reformation in Scotland; by supporting the protestants in France; by the wise and well-managed supplies she sent to the Dutch, who were struggling hard for their lives and liberties with an unrelenting tyrant: by this series of conduct, steadily pursued, she triumphed over all opposition, and rendered herself the arbitress of Europe. For it may be affirmed, that her administration made a greater impression on all the states round her, than it received itself from any: an undoubted proof of its firmness and active vigor.

When she came to the crown, she found the nation four millions in debt: a sum then almost incredible! and yet her economy alone enabled her to discharge it. The coin, which had been much embased by Henry the eighth, and by Mary wholly neglected, she quickly restored to its just standard; and therewith the public faith and credit. Her magazines she carefully replenished with arms, ammunition, warlike stores of every kind: and the youth all over England were ordered to be duly trained in military exercises. Her navy was fallen to decay, and almost abandoned. This she set herself to repair with an attention, which the great bulwark of this kingdom will ever deserve from a prince, who understands in what his own strength and that of his dominions naturally consist. Her fleet was at last a match for the mighty armada of Spain: that armada, which was boasted to be invincible, and was in truth a desperate effort of the whole power and resentment

of her bitterest enemy. Her victory over him, as intire, as it was glorious, gave security and renown to this island: and, whatever the partiality of foreign writers may have insinuated to the contrary, she owed it to her own heroical conduct, and the unexampled bravery of her subjects.

She was the first of our princes who pursued, in any considerable degree, the only sure method of making England great and powerful; by encouraging and extending our commerce; which, under her protection, grew high, and spread itself through the North, and to both the Indies. In a word, such was her conduct, such her good fortune, in this island and on the continent, that her allies had the strongest confidence in her assistance and good faith: that her enemies stood in awe of her power, and were forced to an unwilling approbation of her prudence. The applause of such as think they have cause to hate, and distress us, is the sincerest, as it is the noblest praise. Her economy was admirable. She husbanded the public money for her people's ease: she laid it out, on proper occasions, for their safety and honor. The undertakings of the government were never greater; the charge was never less. This gives the highest idea of her ministry, and places their characters, in general, above imputation or reproach.

Of Sir Nicholas Bacon, our author's father, I have already given some account: and shall only add here, that he never aspired beyond the rank he brought with him to court. His moderation in all other respects was the same. When the queen visited him at his seat in Hertfordshire, she told him with an air of pleasantry, that his house was too little for him. No, replied the lord Keeper; but your majesty has made me too great for my house.

Walsingham, in his private character, was of unblemished honesty. As a minister he had singular sagacity in procuring intelligence; which he knew to apply, with great dexterity, to the purposes of government: devoting himself, with so generous a

self-neglect, to the service of his country, that he gained a reputation for contempt of riches, which would have been highly reverenced in the best times of antiquity; and will go near in these days, to be thought either folly or frenzy.

The lord treasurer Burleigh, for his consummate abilities as a statesman, was reckoned the first name of his age: and is still pointed out as a pattern, which we rather wish, than expect, to see fully copied by his successors in power. As he had strong natural parts, and was of unwearied application to business, his experience must have been universal and unequalled; for he was at the head of the government almost forty years. He seems, in particular, to have been eminently possessed of that intrepidity of head, that civil courage, so necessary in a great minister: and without which no minister will ever do any thing truly noble, or of lasting utility to mankind. Inviolably attached to his mistress, he served her with equal fidelity and success: and had the singular felicity to promote the good of his country by the same arts that he employed to gratify the inclinations of his sovereign.

The glory of this princess will receive a new lustre by comparing the state of England with that of almost all other nations in Europe, at the same time. It must have been no common addition to the tranquillity and happiness of our ancestors, that they enjoyed both uninterrupted, for such a length of years; while Scotland and France, Spain and Holland, were torn with continual divisions, and bleeding by the wounds of foreign and domestic wars. Her's too was the age of heroes both in arts and arms. Great captains, able statesmen, writers of the highest order arose, and under her influence flourished together. Thus Bacon had all the incentives that could kindle him up to a generous ambition, and quicken his emulation in the pursuit of knowledge and honest fame. And indeed his letters remain a proof, that if he courted the proper opportunities of raising his name, he lost none that might

improve and enlarge his mind. As the lord treasurer had married his aunt, we find him frequent in his applications to that minister for some place of credit and service in the state. He professes too, that his views on this head are as moderate, as his aims another way are ambitious and vast; for that he hath taken all philosophy for his province. My lord Burleigh interested himself so far on his behalf as to procure for him, against violent opposition, the office of register to the Star-chamber, worth about 1600l. a year: but it was only in reversion, and did not fall to him till near twenty years afterwards. Neither did he obtain any other preferment all this reign: though his winning address, his eloquence, his large and systematical learning had raised him to the admiration of the greatest men at court. He was particularly esteemed and patronized by Robert Devereux, the famous and unfortunate earl of Essex; to whom he attached himself in his younger years, and by whose interest in the queen he flattered himself with the prospect of bettering his condition. Elizabeth herself shewed him several marks of distinction, admitted him often to her presence, and even consulted him on the state of her affairs: as her ministers sometimes made use of his pen in the vindication of her government. And yet, notwithstanding these fair appearances, he met with no preferment from that queen answerable to the idea we have of his merit, or her discernment in the distribution of favors. This deserves some explanation; as it will discover to us the true genius of those ministers, who, pretending to merit themselves, are jealous of it in all other men: who are equally poor-spirited and aspiring.

Bacon, Vol. III. Letter vii.

The whole court was at this time rent into factions, headed on one part by the earl of Essex; on the other by the Cecils, father and son. Essex was then in all the flower of his youth, and remarkable for the gracefulness of his person. In his nature brave, ambitious, popular: and what is uncommon, at once the favorite of the sovereign and of

the nation. Fond of military glory; liberal to profusion; devoted intirely to his friends, and keeping no measures with his enemies; of competent learning himself, and a signal benefactor to learned men. One quality he had, which distinguishes him eminently from such as are personally beloved by princes: in the height of his favor he received the admonitions, the remonstrances of his friends with all gentleness; and was ever most patient of the truth. But then he wanted those arts which are most necessary in a courtier; and are indeed the only qualities which the rabble of courtiers value themselves upon; circumspection, cunning, affectation of secresy, with a servile obsequiousness to the humours of their superiors, and a mean but anxious attention to their own interest, whether at the expence of their patrons, or of their country. A different turn of mind gave the earl's enemies great advantages against him. They failed not to represent to the queen, on several occasions, that this young lord, not satisfied with the distinction of being her favorite, pretended to be her master; and prescribed to her judgment on affairs of state, with a haughtiness ill becoming the distance betwixt a sovereign and the creature of her bounty. Such insinuations, as they were partly true, could not fail of making an impression on Elizabeth, who was naturally high-spirited, and infinitely jealous of her authority. Though she had a particular fondness for the earl, she took occasion every now and then to mortify his pride, by refusing to advance those friends of his whom he recommended for preferment. After his return from the expedition to Cadiz, in which he had behaved himself with much gallantry, she raised his enemy, Sir Robert Cecil, to be secretary of state; tho' he had earnestly solicited that post for another. He had often applied to her in behalf of Bacon, and asked for him, with all the warmth of friendship, the place of Solicitor General, but had been always refused. Cecil, who mortally hated Essex, and had entertained a secret jealousy of Bacon, on account

of his superior talents, represented the latter to the queen as a man of mere speculation; as one wholly given up to philosophical inquiries, new indeed and amusing, but fanciful and unsolid: and therefore more likely to distract her affairs, than to serve her usefully and with proper judgment. Bacon however was this man's cousin-german; his father and the lord Burleigh having married two sisters: but ambition knows neither merit nor relation. This unworthy treatment from so near a kinsman carried Bacon into very free expostulations on his courtly artifices, as he endeavoured in secret to crush the man whom yet he pretended openly to serve: and these repeated disappointments sunk so deep into his spirit, that he was several times on the point of retiring for ever, and even of hiding his grief and resentment in some foreign country. Essex, who could but ill brook the mortification of a denial, finding himself unable to serve his friend in a public way, would needs make up the loss to him out of his own private fortune: and if we may believe Bushel, he bestowed upon him about this time Twickenham-Park and its garden of Paradise. Whether it was that or some other of his lands, the donation was so very considerable, that Bacon, as himself acknowledges in his Apology, sold it afterwards, even at an under price, for no less than eighteen hundred pounds. A bounty so noble, accompanied too, as we know it was, with all those agreeable distinctions that to a mind, delicately sensible, are more obliging than the bounty itself, must kindle in the breast of a good man the most ardent sentiments of gratitude, and create an inviolable attachment to such a benefactor. What then are we to think of Bacon, when we find him, after this nobleman's unhappy fate, publishing to all England a Declaration of the treasons of Robert earl of Essex? This behaviour drew upon him a heavy and general hatred at that time; which was not extinguished even by his death, but continues still, in the writings of more than one historian, an im-

Bushel's abridg. post. p. 1.

putation on his memory. As this transaction is of importance to his moral character, I will lay it before the reader as impartially as I can.

Elizabeth had raised that young lord, through a series of honors, to be earl Marshal of England: and was every day giving him new proofs of a particular and uncommon esteem. This only served to exasperate his enemies. They were powerful, and closely united. But as they durst not attack him openly, they had recourse to dark and surer arts of vengeance; against which his openness of temper, unsuspecting and improvident, was no wise guarded. In truth, his imperious humor, which he could seldom disguise, aided their designs; for it often broke forth into downright abuse and scorn of those who thwarted his projects, or dissented from his opinions: and he once, in some dispute with the Queen herself, turned his back abruptly upon her with all the marks of disrespect and contempt. Provoked at this insolence, Elizabeth forgetting her sex, and the dignity of her character, struck the earl a box on the ear: which he on his part, with a meanness of passion yet less excusable in a man, resented so highly as to lay his hand on his sword, against a woman and his sovereign. No subsequent favors could wear this imaginary affront out of his memory; though she pardoned him the insult that occasioned it, and sent him shortly after into Ireland, as her vicegerent, with a commission almost unlimited. His conduct there has not escaped the censure of historians, who have remarked severely on the unjustifiable treaty he made with the arch-rebel Tyrone, on the private conference they held together, and on his precipitate return to England, against the queen's express orders. This last ill step he was betrayed into, if we may believe Osborn, by an artifice of Cecil: who first inflamed Elizabeth's suspicions of the earl, and then stopped all vessels that were to sail for Ireland, except one, which he ordered thither on purpose with a feigned report of her death. Fatally deceived by this intelligence,

Mem of Q. Eliz. p. 458.

Essex sailed away in a hurry for England, attended only by a few of his friends. The queen received him without any emotion either of anger or affection, and having confined him to his own house, ordered his conduct to be examined in the Star-Chamber. At this usage of him, however gracious and moderate, the people, whose idol he was, loudly exclaimed: and their unseasonable partiality, represented by his adversaries as of dangerous tendency to the state, kindled anew the queen's indignation against him. Thus that popularity he had so eagerly courted, and so much depended upon, served now only to hasten forward his destruction. He was sentenced by the council to be removed from his place at that board; to be suspended from his offices of earl Marshal and Master of the ordnance, and to be imprisoned during the queen's pleasure. Having humbled him thus far, she stopped short, forbidding his sentence to be entered on record, and still continuing him Master of the horse. She even gave him the full enjoyment of his liberty, upon his expressing a perfect resignation to her pleasure; but withal advised him to be his own keeper. His seeming repentance was of short duration; for upon the queen's refusal to grant him the farm of sweet wines, which he had very imprudently petitioned for, he returned out of the country, and again abandoned himself to all the impetuosity of his temper; or rather to the pernicious suggestions of his followers. Indeed the presumption that naturally grows out of successful ambition, and the interested counsels of those whose fortunes were involved with his, seem to have intirely turned his head: for his actions henceforward were the genuine effects of frenzy and despair. In conjunction with his friends, of several conditions, he meditated no less an attempt than to seize on the palace, to make himself master of the queen's person, and to banish from about her all those whom he reputed his enemies. Never was conspiracy so ill laid, or conducted with so little probability of success. The court was presently

alarmed, his house invested, himself and his friends made prisoners, without any resistance on his part; for though he was embarked in a kind of rebellion, he knew not how to be a rebel. The particulars of his trial are foreign to my purpose. It was managed against him by Sir Edward Coke, the attorney general, and by Bacon as one of the queen's council. It ought not to be forgot that the former treated this unfortunate nobleman with a strain of petulant dulness and scurrility that makes us contemn his talent as a pleader while we abhor the purpose to which he made it subservient. Bacon was moderate and decent. The crime was proved by a cloud of witnesses: and the unanimous suffrage of his peers found him guilty. After his sentence he appeared wholly indifferent to life or death: though the queen seemed still irresolute, or rather inclining to save him. He died with the tenderness of a penitent, and the firmness of a hero: though the marshal de Biron jested on his deportment in that last scene of life, as suiting rather a monk than a soldier.

State Trials, Vol. I. p. 205.

The untimely fate of this nobleman, who died on a scaffold in the prime and vigor of his years, excited universal pity, and was murmured against by all conditions of people. Their reflections on the prevailing party at court, even on the queen herself, were so bold and injurious, that the administration thought it necessary to vindicate their conduct in a public appeal to the people. This task was assigned to Bacon, even then in high esteem for his excellencies as a writer. Some say it was by his enemies insidiously imposed on him, to divert the national resentment from themselves upon a particular person, who was known to have lived in friendship with Essex, and whom they intended to ruin in the public esteem. If such was their intention, they succeeded but too well in it. Never man incurred more universal or more lasting censure than Bacon by this writing. He was every where traduced as one who endeavoured to murder the good name of his benefactor, after the ministry had destroyed his person:

V. A declarat. of the treasons of Rob. earl of Essex, Vol. III.

his life was even threatened; and he went in daily hazard of assassination. This obliged him to publish, in his own defence, the Apology we find among his writings. It is long and elaborate; but not, perhaps, in every part satisfactory. Let us believe him on his own testimony, that he had never done that nobleman any ill offices with the queen; though she herself had, it seems, insinuated the contrary: that on the other hand he had always, during the time of their intimacy, given him advice no less useful than sincere; that he had wished, nay endeavoured the earl's preservation even at last, purely from affection to him, without any regard to his own interest in that endeavour: let all this be allowed; some blemish will still remain on his character. Apology, Vol. III.

Essex deserved the fate he underwent: but he had paid his debt to justice: and the commonwealth had now nothing to fear from any of his party. The declaration above mentioned could therefore be intended, only to still the present clamors of the multitude; and though the matter of it might be true, Bacon was not the man who should have published those truths. He had been long and highly indebted to the earl's friendship, almost beyond the example even of that age. In another man this proceeding might not have been blameable: in him it cannot be excused. In the next reign Sir Henry Yelverton ventured on the displeasure both of the king and his minion, rather than do the ministry of his office, by pleading against the earl of Somerset, who had made him solicitor general. Had Bacon refused that invidious part, there were others, among the herd of aspiring and officious lawyers, ready enough to have performed it: and his very enemies must have thought more advantageously of him for declining a task, in itself of no essential importance to the state, and in him unjust to friendship, obligation, gratitude, the most sacred regards among men. Aul. Coqui, p. 186.

Elizabeth survived her favorite about a year: and, if we may credit Osborn, grief and remorse for his Osborn, p. 459.

fate accompanied her to the grave*. She died the twenty-fourth of March, 1603, in the fulness of days and honor. Her reign had been long and triumphant: and she had through the whole course of it preserved, what she so justly merited, the love and veneration of her people; the truest glory, the rarest felicity of a sovereign! She was succeeded by James the sixth of Scotland, under whom Bacon ascended, by several steps, to the highest dignity of the law.

* He is the first author who mentions the story of the ring.

1603.

This prince, the most unwarlike that ever lived, was born in the midst of civil commotions; at a time when his whole kingdom was torn into factions, betwixt the party who had espoused the interests of his mother, and those who had declared for him. After he had taken the administration into his own hands, he was hardly ever his own master; suffering himself to be led implicitly by the cabal in whose power he then happened to be. The moment he thought himself at liberty from either, like a boy escaped from under the eye of a rigid preceptor, he forgot all his uneasinesses, and abandoned himself to his favorite amusements of hawking and hunting, as if his kingdom had been in the profoundest tranquillity. He grew up in an unaccountable fondness for favorites. The first, who took deep root with him, was likewise the worst; not only encouraging him in a total inapplication to business, but tincturing his youth with the poison of all debauchery. The name of this man was Stuart, afterwards earl of Arran; one who had great and dangerous vices, without a single virtue, private or public, to atone for them: an open scoffer at the obligations of morality, insolent, rapacious, sanguinary, hated by, and hating, all good men. The honester part of the nobility often remonstrated against the credit and pernicious influence of this minion: James acknowledged the justice of their remonstrances; banished him several times from court; and several times received him into new favor. He was at length shot by a private hand in revenge for the death of the earl of Morton, to which he had basely contributed.

Melvil's Mem. p. 131.

Melvil, p. 200.

James hated the church of Scotland; and confirmed its authority. He declared the attempt of those lords, who had rescued him out of the hands of Arran and Lenox, to be just and serviceable: he afterwards banished them, and would have confiscated their estates, on that very account. When they had made themselves masters of his person a second time, he pronounced them all traitors; and pardoned them. Melvil, p. 132. P. 139. P. 169.

Elizabeth, who knew his genius perfectly, sent Mr. Wotton on an embassy to him in 1585. Her intention was to divert him from a marriage with the princess of Denmark, and to give his counsels what other turn her interests might require. The ambassador, a man of address and intrigue, had, by long habitude, learnt to personate all characters, and to assume, with an ease that seemed altogether unaffected, whatever shape might serve most effectually the purposes of his superiors. At the age of twenty-one he had been employed to sound the intentions of the court of France: and had well nigh duped the famous constable de Montmorency, a minister grown grey in the observation of human falsehood and artifice. To his natural talent he had now added the experience of thirty years more. By accompanying King James in his sports; by falling in frankly, and as it were naturally, with all his passions; by making a jest of business; by entertaining him pleasantly with an account of foreign fashions and follies; this man gained an absolute ascendant not only over his understanding, but over his humour. His most faithful subjects, who had served him longest and best, who had even warned him against the subtleties of this stranger, he received with approbation or dislike just as Wotton inspired him. He was even brought by him to be seriously persuaded that the king of Denmark was descended from a race of merchants, and that an alliance with his daughter was therefore infinitely beneath a king of Scotland's dignity. P. 161. P. 164.

Such was the prince who now mounted that throne, which Elizabeth had filled with so great capacity and An. 1603.

reputation. The union of the two crowns in the person of one sovereign, was extremely dreaded by foreigners, and in particular by Henry the fourth of France. The accession of a new kingdom to the native force of England, which even alone had been long formidable on the continent; the alliance of James with the most potent monarch of the North; his relation to the house of Lorrain, which had lately embroiled all France, rendered such fears very probable. But his conduct dissipated them for ever: and all Europe quickly saw, that no people but his own had any thing to apprehend from his power. At his arrival in England, he bestowed titles and honours with so wild a profusion, that there hardly remained any other mark of distinction but that of having escaped them. The public stood amazed: and pasquinades were openly affixed, undertaking to assist weaker memories to a competent knowledge of the nobility. Sir Francis Bacon, who had been early in his homage, and application for favour, to the new sovereign, was knighted by him in person: and has left us the following picture of him, strongly touched in its most obvious features. "His speech," says he, "is swift and cursory; and in the full dialect of his "country: in matters of business, short; in general "discourse, large. He affecteth popularity, by gracing "such as he hath heard to be popular; not by any "fashions of his own. He is thought somewhat ge-"neral in his favours; and his easiness of access is "rather because he is much abroad and in a crowd, "than that he giveth easy audience. He hasteneth "to a mixture of both kingdoms and occasions faster, "perhaps, than policy will well bear."

Wilson, p. 7.

Bacon, Vol. V. Letter LXXIII.

An. 1605.

In 1605, Sir Francis Bacon recommended himself to the king's particular notice, as well as to the general esteem of his cotemporaries, by publishing a work he had long meditated; The Progress and Advancement of Learning. The great aim of this treatise, no less original in the design than happy in the execution, was to survey accurately the whole state and extent of the intellectual world; what parts of it had

been unsuccessfully cultivated; what lay still neglected, or unknown; and by what methods these might be discovered; and those improved to the farther advantage of society and human nature. By exposing the errors and imperfections of our knowledge, he led mankind into the only right way of supplying the one, and reforming the other: he taught them to know their wants. He even went farther, and himself pointed out to them the general methods of correction and improvement in the whole circle of arts and sciences. This work he first published in English: but to render it of more extensive use, he recommended a translation of it into Latin to Dr. Playfer of Cambridge. Playfer, with the scrupulous accuracy of a grammarian, was more attentive to fashion his style to purity and roundness of periods, made out of the phraseology he had gleaned from classic writers, than to render his author's meaning in clear and masculine language. After the sight of a specimen or two, Sir Francis did not encourage him to proceed in it. He himself, after his retirement, very much enlarged and corrected the original, and with the assistance of some friends, turned the whole into Latin. This is the edition of 1623; and stands as the first part to his great Instauration of the Sciences.

Tennison's Baconiana, p.25.

P 27.

I have already observed that Cecil, now earl of Salisbury, opposed the progress of our author's fortune under Elizabeth: and he seems to have observed the same conduct towards him in the present reign, till he had fixed himself in the king's confidence so firmly as to be above all fear of a rival. Besides him, Sir Francis Bacon found a violent and lasting enemy in a man of his own profession, Sir Edward Coke; who, with great parts, had many and signal failings. The quarrel betwixt them seems to have been personal: and it lasted to the end of their lives. Coke was jealous of Bacon's reputation in many parts of knowledge: by whom, again, he was envied for the high reputation he had acquired in one; each aiming to be admired, particularly,

Stephens's Collections, p. ix.

for that in which the other excelled. This affectation in two extraordinary men has something in it very mean, and is not uncommon. The former was the greatest lawyer of his time; but could be nothing more. If the latter was not so, we can ascribe it only to his aiming at a more exalted character. The universality of his genius could not be confined within one inferior province of learning. If learning thus divided is not so proper to raise a singular name in one way, it serves to enlarge the understanding on every side, and to enlighten it in all its views. As the name of Sir Edward Coke will occur oftner than once in this history, and as he stood in particular competition to Bacon, I beg leave to dwell a little longer on his character. In his pleadings he was apt to insult over misery. Of this we have a detestable instance in his behaviour to Sir Walter Raleigh. He inveighed against that brave man on his trial with all the bitterness of cruelty, and in a style of such abandoned railing as bordered almost on fury: I wish I could not add, that this bitterness, this intemperance of tongue, seem to be the genuine effusions of his heart*. He conversed, it seems, more with books than men; and among the latter, with those only to whom he could dictate and give the law. The consequence of which was, that his conversation had all the air of a lecture; and that he retailed for new, a hundred stories that were either stale or trivial. He affected raillery, which was by no means his talent. His wit was often ill aimed, as it was always indelicate and vulgar; the rough horse-play of a pedant. Though he had accumulated immense wealth,

State Trials, Vol. I. p. 207, &c.

* The offices of Attorney and Solicitor General have been rocks upon which many aspiring lawyers have made shipwreck of their virtue and human nature. Some of those gentlemen have acted at the bar as if they thought themselves, by the duty of their places, absolved from all the obligations of truth, honor, and decency. But their names are upon record, and will be transmitted to after ages with those characters of reproach and abhorrence that are due to the worst sort of murderers; those that murder under the sanction of justice.

in his profession and by several rich marriages, he was of a sordid avarice; a severe master, a griping landlord; in prosperity insolent, dejected and fawning in adversity: the same poorness of spirit influencing his behaviour in both conditions. One example of this may serve in place of several: after his disgrace, he submissively courted Buckingham's brother to a match with his daughter: in the height of his favor, he had rejected the same proposal with scorn. His profound skill in the common law has been universally allowed: and to this we cannot have a more unquestionable witness than Sir Francis Bacon; one every way fit to judge, and an enemy. He was raised to be Chief Justice of the Common Pleas in 1606, and of the King's Bench in 1613. On the bench he was above corruption: and had this saying frequently in his mouth, that a judge should neither give nor take a bribe. In the case of Peacham, in the business of Commendams, he behaved himself with the honesty and firmness of one who knew that a judge ought neither to be flattered nor menaced out of his integrity. Towards the latter part of his life, he struck in with the country party in parliament, and stood in the breach against the arbitrary measures of James and Charles. He died in the reign of the latter, aged 88 years.

State Tr. Vol. II. p. 542.

Bacon, Vol. V. Letter CXLV.

At length Sir Francis Bacon obtained the place he had so long expected: and in 1607 was declared Solicitor General. This preferment was the effect of many letters and much instance on his part, to the earl of Salisbury, the lord chancellor Egerton, and the king himself. Neither do I find that he was ever promoted to any post without repeated and earnest application to ministers and favorites: a reflection that may serve at once to mortify and instruct an ambitious man of parts.

An. 1607.

James had, from the beginning of his reign, passionately desired an union of Scotland and England: but his unreasonable partiality to the former, reckoning it as an equal half of the island, rendered the design abortive. Though Sir Francis Bacon labored this argu-

ment with all the arts of wit and reason, his eloquence, powerful as it was, had no effect on the house of commons. The parliament even shewed itself averse to this union, in proportion as the court appeared zealous for it. The new sovereign's conduct had alarmed them. They saw that, with a strong disposition to be profuse, he was absolutely in the power of favorites; and that some of the least valuable among his subjects were most in his favor. They saw farther, that he began already to propagate maxims of government destructive to liberty, and inconsistent with the whole tenor of the constitution. These things filled observing men with apprehensions for the future, which unhappily were but too well founded. The whole sum of his politics, both now and afterwards, was to distaste and alienate his subjects at home; to dishonor both himself and them abroad. It was a reign of embassies and negotiations, alike fruitless and expensive: a reign of favorites and proclamations, of idle amusements and arbitrary impositions. It was besides the great era of flattery. The ancient national simplicity of manners which ever accompanies magnanimity, and manly freedom of speech the noble effect of both, were now in a great measure lost; altered and effeminated into prostitute adulation and servile homage. This was become the fashionable language among the clergy as well as laity, and James heard himself daily addressed to, by the titles of sacred and divine: titles which discover the meanness rather than the dignity of human nature; and which, applied to him, were glaringly ridiculous. He had not one princely quality. The arts of governing a kingdom in peace he either did not, or would not understand: and his horror of war was constitutional and unconquerable. It may therefore seem unaccountable that a king of this temper should treat his parliaments with more haughtiness than any of his predecessors had ever done. But he had been told that England was neither to be exhausted nor provoked: and his actions shewed that he believed so, according to the letter.

The truth is, that as pusillanimity will talk bigger on some occasions than true valor on any; he meant to make himself formidable to his people, that they might not discover how much he was afraid of them.

Though he did not succeed in the union of the kingdoms, he found his judges, in an affair of a similar kind, more complaisant than the great council of the nation had been: I mean the naturalization of all Scotsmen born since his accession to the throne of England. This was adjudged by Sir Edward Coke in the great case of Calvin; as it had been argued at large before all the judges by Sir Francis Bacon. The affair is now no longer of importance to either kingdom: but one assertion of our author, on that occasion, ought not to be forgot. He roundly affirms that monarchies no not subsist like other governments, by a precedent law; and that submission to them is grounded upon nature.

Case of the *Post nati*, Vol. IV.

In 1610 he published another treatise, intitled, "Of the Wisdom of the Ancients." This work bears the same stamp of an original and inventive genius with his other performances. Resolving not to tread in the steps of those who had gone before him, men, according to his own expression, not learned beyond certain common places; he strikes out a new tract for himself, and enters into the most secret recesses of this wild and shadowy region; so as to appear new on a known and beaten subject. Upon the whole, if we cannot bring ourselves readily to believe that there is all the physical, moral, and political meaning veiled under those fables of antiquity, which he has discovered in them, we must own that it required no common penetration to be mistaken with so great an appearance of probability on his side. Though it still remains doubtful whether the ancients were so knowing as he attempts to shew they were, the variety and depth of his own knowledge are, in that very attempt, unquestionable.

An. 1610.

Hobart being advanced to the place of Chief Justice of the Common Pleas, Sir Francis Bacon succeeded him as Attorney General in 1613; about

An. 1613.

three months after the death of his kinsman and enemy the lord treasurer Salisbury: a minister fertile in expedients for supplying his master's wants, and well acquainted with the temper of England: a man of dexterity, craft, and intrigue, rather than a great man. The office that Bacon now entered upon was of exorbitant profit for that age. He owns, in one of his letters to the king, that it was worth to him 6000l. a year; and his employment of register to the Star-Chamber, which I mentioned above, now brought him in 1600l. a year more. By what fatality was it that so extraordinary a man did not add to his other virtues that of a reasonable œconomy? Had he done so, it had preserved him from one transcendent fault: and the other blemishes on his moral name had been lost in the brightness of his intellectual qualities. But he was remarkably subject to the same weakness that so much dishonored his master. His dependents had him wholly in their power, and squandered his fortune away, shamefully and without measure. In a private family, this begot disorder, necessity, corruption: and all England beheld, from the same management in administring the public, the same effects; only more felt and fatal, as they were universal.

It was not however till the year 1611 that James abandoned himself to one sole favorite. About that time was brought to court Robert Car, a Scotsman, then in the first bloom of his youth, and of distinguished beauty; by which he at once engaged the king's attention, and in a little while ingrossed all his affection. As he was wholly illiterate, James himself would needs be his preceptor: and it must have been a scene altogether new and ridiculous, to see the sovereign of three kingdoms daily instructing, in the first elements of grammar, the man who was shortly after to govern those kingdoms. In his bounty to this stripling, he observed no other measure but that of his passion, which was as extreme as it seemed unaccountable. Car, in four or five years of favor, from a mere adventurer was raised to be earl

Truth brought to light, p. 89.

of Somerset: and amassed an enormous estate of nineteen thousand pounds a year in land; besides plate, money, and jewels, to the amount of two hundred thousand pounds more. And yet he deserves a place in history, only for his scandalous amour with the countess of Essex; for procuring her An. 1613. to be divorced from her husband, and for combining with her to poison his friend, who had dissuaded him from that ill step. The fate of Sir Thomas Overbury; the dark and dreadful scene of guilt that ushered it in; and the part those two great criminals acted in that tragedy, are recounted by all historians. Though the horrible transaction lay yet wrapt up in darkness, and was not discovered till two years after, remorse and the upbraidings of conscience pursued Somerset every where. Through all the splendor of fortune and favor, the trouble of his mind was visible in his countenance, in his whole deportment. He grew by degrees to neglect his person and dress; his Coke. sprightliness of temper left him: and his conversation, from being gay and entertaining, was become cold, serious, and gloomy. This alteration in him was quickly followed by a change in the king's affections; which had no deeper or more solid foundation than these external and slight accomplishments. The courtiers, whom envy and interest render extremely sharp-sighted, quickly discovered this change, and improved it. Luckily for their designs, there now ap- An. 1615 peared at court another young man, fitted by nature to draw the curiosity of James, and to supplant the earl of Somerset in his favor. This was the famous Wilson, George Villiers, the younger son of a good family in p. 79. Leicestershire; afterwards duke of Buckingham. As the surprising elevation of this youth had a particular influence on the future fortunes, and even on the fall of Sir Francis Bacon, his character will deserve a place at large in this history.

His mother, who could not give him a fortune, bestowed on him such an education as might enable him to acquire one, especially in a court like this. The advantages he owed to nature, such as a handsome

face, a body exactly proportioned, an ease and gracefulness in his motions, she had taken care to improve with that elegance of manners, that artificial politeness, and skill of excelling in trifles, which are the last finishings of a French education. In a word he was just returned from his travels, and accomplished in all those agreeable and frivolous arts, which were a certain recommendation to the favor of James. The earls of Pembroke and Bedford, with some other lords who were secret enemies to Somerset, after dressing out this youth with a studied exactness, placed him to advantage in the king's eye, at a comedy. That monarch was immediately smitten with his face, air, and appearance; which yet he endeavoured for some time to conceal. Nay he carried this dissimulation so far that he would needs be solicited by the queen to receive Villiers into his bosom: imagining the world would be thus deceived into a belief that he rather followed her advice, in this matter, than his own inclination. Such was the kingcraft on which he so highly valued himself. The queen was not easily prevailed with to take this step; of which she foresaw all the consequences. At last, however, she yielded to the archbishop's importunity; telling him at the same time, that those who labored most to promote Villiers might be the first to feel his ingratitude. Upon this he was immediately knighted, and declared gentleman of the bed-chamber: the herd of courtiers rivalling each other in their offers of friendship and service to him. Some of them even descended to undertake his quarrels, and brave such as were still in Somerset's interest.

Rushworth of Abbot, ch. 1.

Weldon, p. 84.

Among those who courted the rising favorite, none was more zealous than Sir Francis Bacon; as none was able to serve him more nobly, or more usefully. Villiers had at this time sense enough to feel his inexperience in business, and therefore had recourse to our author for his advice: which he gave him fully in a letter, still extant among his works; written with so superior a judgment and so much honest freedom, that it does honor equally to his head

Bacon, Vol. III. Advice to Sir G. Villiers.

and heart. He has ranged his thoughts under seven or eight principal topics of consideration, and entered into an accurate detail of what a minister ought to know and practise. In another letter to him, he has these remarkable words: "It is now time that you "should refer your actions chiefly to the good of your "sovereign, and your country. It is the life of a "beast always to eat, and never to exercise. In "this dedication of yourself to the public, I recom-"mend to you principally that which I think was "never done since I was born, and which, not done, "hath bred almost a wilderness and solitude in the "king's service: which is, that you countenance "and encourage, and advance able and virtuous "men in all kinds, degrees, and professions." This excellent advice the favorite received with thankfulness; and neglected.

Though the king's passion was now wholly diverted upon a new object, he still affected to treat Somerset with kindness and distinction; even after the discovery of his being an accomplice in poisoning Sir Thomas Overbury had rendered this dissimulation not only mean but criminal. Yet he continued it to the last, embracing with fondness the man whom he had secretly ordered to be arrested: and intreating him to hasten his return, when he believed he should never see him more. In such trifles he was fond to exert his talent of political management. The earl's unhappy passion for the young countess of Essex was the source of all his misfortunes, and drew after it the most terrible consequences: ending, as I have already observed, in the murder of his friend; in the ruin of himself, and of her to whom he had treacherously sacrificed that friend. The whole affair is displayed at full length in our author's charges against those two prime agents in that infernal conspiracy. They were both found guilty, sentenced to die, and afterwards pardoned by the king, notwithstanding his solemn imprecations to the contrary, on himself and his posterity.

An. 1616.

Wilson, p. 81.

May 24, 25. State-trials, Vol. I. p. 334, 348.

Certain historians have remarked, that there was something in the behaviour of Somerset before his trial, singular and mysterious; and that his master likewise seemed to labor under a secret anxiety of mind, equally surprising. The earl, they pretend, said aloud in the Tower, that the king durst not bring him to a trial. Others reject this account as a downright calumny, invented merely to fix a black and cruel imputation on that prince's memory: or affirm at least that it was founded only in popular rumour and malicious conjecture. But that there was more in it than conjecture, may be proved by undoubted authority; by some original letters of Sir Francis Bacon, then Attorney General, and particularly employed in this very affair. Those letters have, I think, escaped the observation of all our writers: I shall therefore quote from them such passages as may serve to throw some light on this dark transaction; though not enough perhaps to discover the darker motives that influenced the king's and the earl's behaviour in it.

Bacon, Vol. V. Letter cxxxvi.

James himself selected certain persons to examine Somerset with all secrecy, and marked out to them the particular articles on which they were to interrogate him. They had withal orders to work upon his obstinate temper by every method of persuasion and terror: to give him now hopes of the king's compassion and mercy; and now to assure him that the evidence was full to convict him, so as there needed neither confession nor supply of examination. Bacon, who was one of them, adds that they found his deportment sober and modest, different apparently from other times. In another letter he has these remarkable words: "That the same little charm "which may be secretly infused into Somerset's ear "some hours before his trial, was excellently well "thought of by his majesty: only I could wish it a "little enlarged; for if it be no more but to spare his "blood, he hath a kind of proud humor that may "over-work the medicine." All this was to be done with much caution and privacy; for the very ser-

Vol. V. Letter cxxxix.

jeants, appointed to manage part of the trial, were not yet in the secret how the king would have it carried on: and therefore Bacon, to cover from them what he knew of the matter, desired that some general heads of direction might be sent to them all. From hence it appears that James shewed an extreme solicitude about the earl's behaviour, and the event of this affair. To what can it be attributed? His affection for Somerset was extinguished: and he lay under the strongest obligations of public honor and justice not to screen, from the censure of the law, a man whose guilt was of the most crying enormity. The earl's standing mute, or denying that guilt, especially as the proofs of it were strong and pregnant, could bring no possible imputation on his name. Why then all this dark practice? all these artifices of the persons who examined him, only to make him submit to be tried, and to keep him in due temper during his trial? There is still more. James ordered his Attorney General to forecast and put in writing every possible case with regard to the trial, and accompany them with his own opinion on each; that no surprise might happen, but that things duly foreseen might have their directions and remedies in readiness. Accordingly Sir Francis Bacon sent a writing of that purport, on which there are several observations in the king's own hand. I will only quote one passage from it: "All these points of "mercy and favor to Somerset are to be understood "with this limitation; if he do not, by his con- "temptuous and insolent carriage at the bar, make "himself incapable and unworthy of them." The king's remark in the margin is in these words: "That "danger is well to be foreseen, lest he upon the one "part commit unpardonable errors; and I on the "other part seem to punish him in the spirit of re- "venge." Somerset was not to be tried for any offence against the king; but for the barbarous murder of a private man and his friend. What then means the contemptuous carriage that is so much apprehended? What are the unpardonable errors it may

Bacon, Vol. V. Letter CXXXVIII.

lead him to commit? If he reflected on a master, to whom he had been so much obliged, only for giving him up to a fair and equal trial, to a trial by many circumstances rendered inevitable; that would, in the opinion of all mankind, only aggravate his crime, and furnish a new motive to that master for letting the sentence of justice pass upon him in all its rigor.

Court of K. James I. p. 106. After these particulars, I may venture to mention a fact related by Sir Antony Weldon, who says, that when the lieutenant of the Tower, Sir George More, came and told the earl he must prepare for his trial on the morrow, he absolutely refused to appear unless they dragged him to it by violence; adding, that the king durst not bring him to trial. Astonished at such rash and dangerous expressions, the lieutenant, though is was then midnight, went and demanded an audience of the king, to inform him of what had passed. James, upon hearing his story, burst into a passion of tears, and intreated More to use his utmost skill upon his prisoner and soothe him, by whatever means, into proper temper and submission. This More undertook to do, and by a stratagem effected it. Weldon affirms he had this story from the lieutenant's own mouth: and though he is a partial writer, and indulges himself in a humour of licentious scandal, the authentic vouchers I have produced, render his anecdote not improbable. Other circumstances, mentioned by those who have professedly written of this reign, I therefore omit, and shall only add, that there is in the Cabala a letter to king James from Somerset after his condemnation, of a very peculiar turn. He desires that his estate may be continued to him intire, in a style rather of expostulation and demand than of humility and supplication: and through the affected obscurity of some expressions, one may discover, that there was an important secret in his keeping, of which the king dreaded a discovery. The issue was, that James continued to him a pension of four thousand pounds a year, as long as he lived.

Cabala, p. 204. edit. 1691.

Prince Henry died in the year 1612, universally

lamented. His excellent qualities had endeared him to the love and expectations of all England. Germanicus was not more the darling of the Roman people: and the untimely end of both those princes was universally believed to have been procured by poison. He had expressed, on all occasions, an abhorrence of minions, and an utter contempt of Somerset: he had even declared a firm resolution, to humble both him and the family into which he was allied, if ever he came to reign. Whether the unaccountable transaction I have been relating has any reference to the death of this amiable prince, or whether it does not point rather to an affair of a very different nature, the reader is left to determine.

Villiers, now without a rival in the king's affections, was every day receiving new proofs of his bounty; at the same time that he more than shared with him the exercise of his authority. In the course of a few years he was made Gentleman of the bedchamber, Master of the horse, Knight of the garter, earl, marquis and duke of Buckingham, Chief justice in eyre of all the forests, and lord High Admiral of England. One of those prodigies of fortune, who rise now and then upon the world, as the vulgar imagine of comets, at once to astonish and scourge it: a signal instance of the wantonness of sovereign power, and how far it may insult human kind in exalting and adorning what it should neglect or contemn. He drew up after him an obscure kindred, numerous and indigent, bestowed on them places of trust and profit, married them into the noblest families, and graced them all with dignities, which were to be supported at the common expence of a whole people; to whom if any one of them was merely harmless, it was his utmost praise. After having read, not only what the enemies of this favorite have said against him, but all that his partizans have alledged on his behalf, I do not find during the whole time of his influence under two reigns, an influence supreme and unbounded, that he ever projected one scheme for the benefit of his country, or ever executed one under-

taking to its honor; the only great criterion by which we ought to judge those men that administer the public. The breaking off the Spanish match at last was solely a sacrifice to his own vanity and resentment. On the caprice of this youth, however, the first and ablest men in the kingdom were to depend entirely, for their access at court, for their advancement, for any opportunity of being able to serve their country and their sovereign. Sir Francis Bacon was sensible of this, and courted his friendship with a particular application. But he must have felt all the servitude and disagreeableness of his situation, when, to be well with the king, he found it necessary to turn steward to the estate newly bestowed on this young man; to study the ways and means of improving his lands, and of rendering his places most profitable to him. It is true he found his account in this service; as it proved the surest means of his own preferment: but, to a great and worthy mind, preferment so meanly obtained is disgrace, only a little disguised and gilded over.

Bacon, Vol. V. Letter CLXVI.

Cabala, p. 219.

The lord Chancellor Egerton, broken with age and infirmities, had often petitioned the king to be dismissed from his laborious employment. He was now seventy-seven years old, and had presided in the court of chancery from the year 1596, with an unblemished reputation as a judge in private cases; but his public conduct had been always framed to the directions of the court with an obsequiousness, of dangerous example in one, who held so great and important a trust. To this high dignity Sir Francis Bacon privately aspired: and as it was the utmost scope of his ambition, he had aimed all his endeavours in the king's service to merit it at his hands. He took care, at the same time, to strengthen his pretensions by the credit of Buckingham. His ambition even made him descend to artifices, that are as common in courts, as they are mean and unwarrantable; for he endeavoured to ruin in the king's good opinion such men as the voice of the public might probably design to the same office, and whom he therefore considered as his rivals. He was parti-

cularly jealous of Sir Edward Coke, and represented him as one who abounded in his own sense; one who affected popularity, and likely to court the good will of the nation at the hazard of the prerogative. For himself, he placed his great merit in obedience and submission; in the interest he had among the Commons, and in being able to influence the lower house of parliament: a service which he magnifies as more important in a Chancellor, than to judge in equity between party and party. This opinion of his own popularity in the nation was not groundless. The parliament that met in 1614, though extremely out of humor with the ministers in general, distinguished him by an uncommon mark of favor and confidence. An objection having been started in the house of commons, that a seat there was incompatible with the office of Attorney General, which required his frequent attendance in the upper house: the commons, from their particular regard for Sir Francis Bacon, and for that time only, overruled the objection; and he was accordingly allowed to take his place among them. If I observe farther, that the king raised him to the dignity of a privy-counsellor while he was still in this very office, it will be instead of many instances to shew, with what an addressful prudence he steered his course betwixt the court and the nation. He was thus favored by a prince, who exacted from all his servants an implicit submission to his maxims of government: he gave no umbrage to a parliament whom these maxims had rendered jealous of the prince, and of almost every man in his favor. But to return.

Bacon, Vol. V. Letter cxxvii.

Petyt's *Placita Parliam.* p. 174.

These insinuations had their desired effect. Upon the Chancellor's voluntary resignation of the seals, they were given to Sir Francis Bacon, with the title of lord Keeper, on the seventh of March 1617. To what interest he more particularly owed this promotion we may learn from his letter of acknowlegement, written that very day, to the earl of Buckingham.

An. 1617.

Bacon, Vol. V. Letter clxix.

A few days after he had the seals delivered to him,

the king went a progress into Scotland, carrying with him the favorite, who was likewise his prime minister: for to him all business, public or private, was addressed; and, according to his fancy, for the most part determined. The great affair that employed the deliberations of his council about this time, and had a fatal influence on his conduct ever after, was the marriage of prince Charles with the Infanta of Spain. In this resolution, though contrary to all the rules of good policy, he persisted for seven years together; against his own interest, against the universal voice of his people: only to procure the imaginary honor of an alliance with a crowned head; for all other alliances he thought below his dignity. Sir Francis Bacon, who saw through the vanity and danger of this intention, but who wanted resolution to be greatly honest, contented himself with insinuating softly, that it would be necessary to have the council unanimous in their suffrage on the occasion, whatever might be their private sentiments. This hint was not sufficient to open the king's eyes. On the contrary, he run blindfold into the snare that Gundamor was spreading for him. That famous statesman, as much by his buffooneries as by his talent for intrigue, had gained an absolute ascendant over James, leading him on from error to error: till in the end he made him sacrifice his conscience to the pope, and his honor to the resentments of Philip, in the murder of his bravest subject Sir Walter Raleigh; the last terror of Spain, and the only surviving favorite of queen Elizabeth. The Dutch too made advantage of the king's weakness and necessities. As the cautionary towns were still in the hands of the English, the States were under some apprehensions that the Spanish ministry might prevail upon James, who could not possibly conceal his fondness for the match in treaty, to put those important places into their power. They knew at the same time that his treasury was exhausted, and that his courtiers were insatiable. To bring their purpose about, they ceased all at once to pay the English who

Bacon, Vol. V. Letter CLXXV.

Rapin.

garrisoned those places, as by their treaties they were obliged to do. Complaint being made of this to the Dutch envoy at London, he insinuated, as from himself, to some of the ministers, that if king James would desire it of the States, they would, out of consideration for him, take up money at an exorbitant interest, and in one payment discharge the whole debt due to the crown of England. This stratagem took effect. James wrote to the States; and the matter was immediately put into negotiation. The pensionary Barnevelt, whom they sent over, conducted the affair with so much address, that the king agreed to deliver up the cautionary towns for less than three millions of florins, in lieu of eight millions they had engaged to pay Elizabeth, besides the interest that had been running on for eighteen years. Such are the events of this reign; fit only to depress the writer, and distaste the reader.

During the king's absence in Scotland there happened an affair, otherwise of small importance, but as it lets us into the true genius of those times, and serves to shew in what miserable subjection the favorite held all those who were in public employments. He was upon the point of ruining Sir Francis Bacon, the person he had just contributed to raise, not for any error or negligence in their master's service, but merely for an opinion given in a thing that only regarded his own family. Indeed such was the levity, such the insolence of his power, that the capricious removal of men from their places, became the prime distinction of his thirteen years favor; which, as bishop Hacket observes, was like a sweeping flood, that at every spring-tide takes from one land, to cast what it has taken upon another. The affair was this. The year before, my lord Coke had been removed from his place of Chief Justice, and disgraced: the court having found him, in several instances, no friend to arbitrary will and pleasure, or to the prerogative, as it was called; but resolutely bent to maintain the integrity and honor of his post. One Peacham had been accused of in-

Life of Abp. Williams, Part I. p. 19.

serting in a sermon several passages accounted treasonable, for it seems they reflected on the ministry; but in a sermon never preached, nor ever intended to be made public. The king, who was beyond measure jealous on this head, fearing the man might either be acquitted on his trial, or not condemned to capital punishment, had ordered his attorney general Bacon to sound the judges before-hand, and gather their opinions secretly and apart. My lord Coke obstinately refused to declare his; looking on this auricular taking of opinions, for so he named it, as not according to the custom of the realm, but new, and of pernicious tendency. About the same time he had determined a cause at common law. The plaintiff, who thought himself injured, would not abide by his decisions, but applied to chancery for relief; where the defendant refused to appear, disclaiming the authority of that court: in which he was supported by the Chief Justice, who threatened the Chancellor with a premunire, grounded on a statute made 27th Edw. III. for thus invading the limits of his jurisdiction. The king, who thought his prerogative struck at anew in this attack on the court of his absolute power, as Bacon styles it, had the matter examined before the council; who condemned the Chief Justice for what he had done, and obliged him to make a submission on his knees. But what completed the distaste taken at him, was his behaviour in a cause of the bishop of Litchfield and Coventry, to whom the king had granted a vacant church in *commendam*. Serjeant Chiborne, who was counsel against the bishop, in arguing the case had maintained several positions, reckoned prejudicial and derogatory to the king's supreme and imperial power, which was affirmed to be distinct from, and of a higher nature than his ordinary authority. Informed of this, James, by his attorney general Bacon, ordered the Judges to stay further proceedings in that business, till they had consulted with him. The judges assembled, and unanimously agreed, that they could not obey this order; that

Bacon, Vol. V. Letter CXII.

Bacon, Vol. V. Letter CXXVIII, CXLV.

Letter CXLV, CXLVIII.

the letter they had received was contrary to law; that by their oath and the duty of their places they were not to delay justice; that they had therefore proceeded in the cause at the time fixed: and of this they certified the king in a writing under all their hands. Upon this remonstrance, he writ them an angry letter, and peremptorily commanded them to stay all proceedings, till his return to London. They were then summoned before the council, and sharply reprimanded for suffering the popular lawyers to question his prerogative, which was represented as sacred and transcendent, not to be handled or mentioned in vulgar argument. At last raising his voice to frighten them into submission, he put this question to them severally: "If, at any time, in a case depending be- "fore the judges, he conceived it to concern him "either in profit or power, and thereupon required to "consult with them, and that they should stay pro- "ceedings in the mean time; whether they ought "not to stay them accordingly?" They all, the Chief Justice only excepted, acknowledged it their duty to do so. His answer deserves to be for ever remembered: "That when such a case happened, he "would do that which should be fit for a judge "to do." Bacon, Vol. V. Letter CXLVIII.

Yet this great lawyer, who had the honest courage to resist the king to his face, wanted that independence of mind which alone enables a man to bear solitude, and an acquaintance with himself. His disgrace, which reflected more honor on him than all his preferments, he was unable to support; and therefore he soon after sued to be reinstated in the king's favor. To recover it, he meanly enough courted the favorite with an offer, which he would not hear of when it was formerly made to him. While in power, he had refused to give his daughter in marriage to Sir John Villiers, not without marks of disrespect: he now submissively intreated the same person to honour him with his alliance: and employed Secretary Winwood to inform the earl of Buckingham of his extreme concern for what had Bacon, Vol. V. Letter CLXXX, CLXXXI.

passed with regard to the earl's brother; that he now passionately wished the treaty might be renewed and accomplished; adding, that they should make their own terms of settlement, if his proposal was accepted. As the young lady was not only a celebrated beauty, but a great fortune, the person most interested made no difficulty to close with this proposal: and his mother recommended it to her second son with warmth. This alarmed the lord keeper Bacon. Ever jealous of Coke's reputation, and at odds with him, he dreaded his alliance with so powerful a family. His imagination suggested to him all the danger that threatened his present and future fortunes from this union: and he could not forget that he had lately treated his antagonist with a freedom that rather insulted than admonished him. These apprehensions made him cast about how to defeat the intended match, by raising such objections to it as might touch the king and his favorite in point of public honor and advantage. His letters to both, on that occation, are written with the perplexity of a man who fears something he is unwilling to own; which yet his prudence passes over with a seeming unconcern, to enlarge only upon considerations that regard those whom he would be thought to serve. But this management proved ineffectual. It was resented by the earl of Buckingham, and checked by a rough answer from the king. The lady Compton, too, informed of the part he was acting, gave a loose to her tongue, and railed at him with a bitterness natural to women when they are thwarted in any favourite pursuit of interest or passion. Having thus, to prevent a distant and uncertain danger, involved himself in one that was real and immediate, he made no scruple to change sides at once; to go directly against his former opinion; and to offer unasked his interest in the young lady's mother for promoting the match he had just been labouring to disappoint. On such trivial accidents do the fortunes of ministers depend: and to such little and shameful arts is ambition often obliged to stoop. Nor even thus did he presently regain his

Bacon, Letter CXLII, to L. Coke.

Letter CLXXXIV.

credit with Buckingham. The family continued to load him with reproaches: and he remained long under that agony of heart which an aspiring man must feel, when his power and dignity are at the mercy of a king's minion, young and giddy with his elevation, and who thinks himself offended. They were however reconciled at last; and their friendship, if obsequiousness in one to all the humours of the other deserves the name of friendship, continued without interruption for some years; while Buckingham went on daily to place and displace the great officers of the crown, as wantonness of fancy, or anger, or interest led him; to recommend or discountenance every private person who had a suit depending in any court, just as he was influenced; to authorize and protect every illegal project that could serve most speedily to enrich himself or his kindred. In a word, he became formidable even to the master who had raised him from the dust, and who should have still awed him by his authority: and this amidst the dissipation of a life, given up to idle amusements, or sullied with criminal pleasures.

In the beginning of 1619, Sir Francis Bacon was created lord high Chancellor of England, and shortly after baron of Verulam; which title he exchanged the year following, for that of viscount St. Albans. Such events in his life as these may be passed over slightly: he was so great a man, that external honors could add no lustre to his name. Indeed had they been the immediate reward of those nobler services he had done, and was still meditating to do his country, they might deserve more particular notice, for the sake of him who bestowed them. An. 1619.

Neither the weight and variety of business, nor the pomps of a court, could divert his attention from the study of philosophy. Those were his avocations and incumbrances; this was his beloved employment, and almost the only pleasure in which he indulged his freer and better hours. He gave to the public in 1620 his *Novum Organon*, as a second part to his grand Instauration of the Sciences: a work that for An. 1620.

twelve years together he had been methodizing, altering, and polishing; till he had labored the whole into a series of aphorisms, as it now appears. Of all his writings this seems to have undergone the strictest revision, and to be finished with the severest judgment. Indeed the form into which it is cast admits of nothing foreign, of nothing merely ornamental. The lights and embellishments of imagination, the grace and harmony of style, are rejected here, as beauties either superfluous, or of an inferior nature. The author has, besides, made use of several terms in a new and peculiar sense, which may have discouraged some readers, as it has made others imagine them equally unintelligible with the horrors of a vacuum, the quiddities, and substantial forms, of the philosophy which he attempted to discredit: and therefore, of all his writings it has been the least read, or understood. It was intended as a more useful, a more extensive logic than the world had yet been acquainted with: an art not conversant about syllogisms, and modes of argumentation, that may be serviceable sometimes in arranging truths already known, or in detecting fallacies that lie concealed among our own reasonings and those of other men; but an art inventive of arts: productive of new discoveries, real, important, and of general use to human life. This he proposed, by turning our attention from notions to things; from those subtle and frivolous speculations that dazzle, not enlighten, the understanding, to a sober and sensible investigation of the laws and powers of nature, in a way becoming sages who make truth and information the sole aim of their inquiries. In order to this, his first endeavor was to weed out of the mind such errors as naturally grow in it, or have been planted there by education, and cherished by the influence of men, whose writings had long claimed a right of prescription to rule and mislead mankind. To a mind thus prepared for instruction, he proposes the second and scientifical part of his scheme, the true method of interpreting nature, by fact and observation; by sound and ge-

nuine induction, widely differing from that puerile art which till then had solely prevailed in philosophy. His requires a sufficient, an accurate collection of instances, gathered with sagacity and recorded with impartial plainness, on both sides of the question: from which, after viewing them in all possible lights, to be sure that no contradictory instances can be brought, some portion of useful truth, leading on to further discoveries, may be at last fairly deduced. In this way, experiments and reasonings grow up together, to support and illustrate each other mutually, in every part of science.

As we are now approaching towards the most memorable event of our author's public life, which ended in a melancholy reverse of his fortune and honor, it will be necessary to trace, step by step, the causes that produced it: especially as the affair has not been hitherto considered in the point of view that renders it most interesting and instructive. It will, I believe, appear with evidence, that, whatever his crimes might be, he was sacrificed to the safety of another, far more criminal than himself: and that this was the act of an ill-judging master, with whom it was a greater merit to be amusing in any degree, than to be serviceable in the greatest. An. 1621.

Among the weaknesses of king James, his vanity was the most pernicious to his own family, and to the nation in general. He placed an infinite value on certain chimerical advantages that met in his person; on that inherent right by which, he pretended, the crown of England was devolved to him; on his long acquaintance with the prime mysteries of government; and on his uncommon accomplishments in learning. His favorite maxim was, that he who knows not how to dissemble, knows not how to reign: but he seems not to have heard of a second maxim, without which the first cannot be successful, even for a time; to conceal every appearance of cunning, and to deceive under the guise of candor and good faith. He, on the contrary, shewed his whole game at once, to his own subjects and to

foreigners alike: so that in his attempts upon the former, in his negotiations with the latter, this Solomon was the only dupe. A great share of learning he certainly had, but of learning that a king ought not to be acquainted with; the very refuse of the schools, which served for little else but to furnish him with an impertinent fluency, on every subject: and he indulged himself in the sovereign pedantry of setting it to show, on every occasion. On all these heads, he was extolled without measure by the most pestilent of flatterers, grave and reverend ecclesiastics: for which, and because they encouraged him in an unprincely application of his talent, he, on many occasions, made his power the mean instrument to gratify their passions and lust of dominion. They, in return, found out for him a title antecedent and superior to human laws, even a divine right of being weak or wicked, without control. And this doctrine, horrible as it is, they dared to derive from Scripture: where, if it could be found, which to affirm were blasphemy, it would be the triumph of infidelity, and demonstration that those sacred writings were inspired, not by God, but by some being, his opposite and the enemy of all goodness. This doctrine, meeting with his own perverted habits of thinking, made king James look upon his subjects as slaves; upon his parliaments as usurpers of a power to which they had no right, or at best a precarious one: and he had now, for seven years together, affected to govern without them; to set up an interest separate from that of his people, and to supply his wants by all ways and means, but such as the constitution prescribed. These methods were suggested to him by the worst enemies of the commonwealth, the tribe of projectors and monopolists: miscreants, who sheltered themselves under the name and influence of Buckingham, and who repaid his protection extravagantly, at the expence of a people whom they were grinding and devouring. His mother too, now created a countess in her own right, a woman born for mischief, of a meddling spirit and insatiably greedy, was deep in

Hacket, p. 50.

the guilt of these transactions; forwarding every bad project that brought her in money; and, by the mighty power she had over her son, succeeding in every scandalous job she undertook. Under an administration like this, when England was in effect governed by a dissolute youth, himself in the hands of an intriguing, rapacious woman, it cannot be surprising that the people were vexed and plundered by illegal patents, by monopolies, by other mischievous projects, calculated to enrich a few, and to ruin thousands. To all these patents, however procured, the chancellor had readily, almost implicitly, affixed the seal, as the mere creature of Buckingham: or if he ever ventured to insinuate that any of them were contrary to law, his remonstrance was too fearful and unsupported to produce any effect. This is the great stain on his character, that he deserted, or neglected, the post of honor where providence had placed him, on the frontier, if I may so speak, betwixt Prerogative and Liberty; that, if he did not encourage, he at least connived at, the invasions that were every day making into the latter. Yet this was against his inclination, as well as against his better sense of things; for as he knew well that his master's true interest lay in a good understanding with his people, he had often advised him to call frequent parliaments, and to throw himself on the affections of the nation for the support of his government. Though such advice was repugnant to all the maxims by which that monarch wished to establish his power; though he had resolved to lay parliaments aside for ever, as daring encroachers upon his prerogative, who made themselves greater and their prince less than became either: yet he was now prevailed upon to meet the two houses once more. Indeed the exigency of his affairs rendered it necessary. His subjects, it is true, were harassed and pillaged; but he was still in extreme want of money: those wretches, to whom he delegated his authority, leaving to him little else besides the public hatred, occasioned by their rapines committed in his name. Add to this, that the junc-

ture appeared favorable for obtaining large supplies from the commons. As the whole body of the nation expressed an uncommon zeal for recovering the Palatinate to his unfortunate son-in-law, he had reason to expect, that, on assurance of his entering heartily into a war, they would vote him considerable aids of money; which he might afterwards divert, as he actually did, to other purposes that better suited his genius and notions.

A parliament was accordingly summoned: and it met on the 20th of January 1621. The king was not wholly mistaken in his conjecture: for the commons immediately voted him two intire subsidies; but went at the same time into a strict inquiry into those arbitrary impositions, that, in a period of seven years, were become insupportable to the people. Among the monopolies, in particular, there were three of flagrant injustice and oppression. Certain persons had obtained patents from the king, which impowered them to set an annual fine on such as kept inns, or alehouses throughout England. Without a licence from the patentees, no man could hold either: and whoever would not readily pay the sum, at which those low instruments of power thought fit to excise him, was sure of being harassed and plundered, or thrown into a jail. This proved a fruitful source of vexations, and fell heavy on the poorer sort. The third was yet more enormous; a patent for the sole making and vending of gold and silver lace, which had been granted to two infamous tools of the favorite, Mompesson and Michel; the Dudley and Empson of that age. The first a man of fortune, whose sole ambition was to make himself considered, though but by his crimes: the other an obscure justice of the peace, who, in a remote quarter of the town, picked up a sordid maintenance from the stews. They had, it seems, shamefully abused the power their exclusive patent gave them, by putting off, for true, great quantities of counterfeit lace, wrought up and embased with copper, or other materials of a poisonous nature: and whoever presumed

to make or sell any other was cruelly punished, by fine and imprisonment. In these outrages they were the more daring, because Sir Edward Villiers, half-brother to the favorite, was associated into their patent, though not named in it. These, with many other grievances, were laid open in parliament, and severely censured. But the commons did not stop here. They were for carrying their search up to the prime cause of all grievances, in order to discover by whose influence the several patents had been procured, and how they had passed the seals. Complaints were brought into the house, about the same time, of corrupt practices even in the high court of Equity. This alarmed the king for his chancellor, and still more for his minion: as private intimation had been sent to Buckingham, of a severe scrutiny that was making into all his management, and of frequent meetings that were held, with great secrecy, by certain members of the lower house; in order to fix on him the guilt of whatever was most unjustifiable and oppressive. Buckingham's creatures, anxious and alarmed at this intelligence, persuaded him that he could secure impunity to himself and them, only by bringing his master forthwith to dissolve the parliament: and James had certainly been frightened into that rash and hazardous step, but for the sober remonstrances of Williams dean of Westminster. That politic courtier advised him to cancel at once, by proclamation, all monopolies and vexatious grants; to sacrifice inferior criminals to the public resentment, and to soothe the parliament with an assurance that this reformation was first proposed by his favorite, on finding how much he had been abused by designing and knavish projectors. This counsel the king resolved to follow; but it did not wholly free him from the perplexity he was under. The chancellor, whom his interest led him to preserve, was openly accused of corruption: the favorite, whom his tenderness could not resign, was secretly, and therefore more dangerously attacked; as the encourager, if not the author, of whatever was deemed

Hacket, p. 49. Wilson.

Cabala, Letter 11.

Bushel's Abridg. Post. p. 2, 3.

most illegal and oppressive. To save both, at this juncture, would be impossible: and he found he must either part with the object of his inclinations, or with the oracle of his counsels. How such a prince would determine, is easy to guess. His passion prevailed over his reason: and my lord St. Albans was made the scape-goat of Buckingham. He was even obliged to abandon his defence. As he had gained universal esteem by his learning; and as his eloquence was equal to his parts, superior and commanding, the king would not hazard his appearing before the lords to plead his own cause. In the course of such an inquiry, he might have diverted the public odium from himself, by laying open the long series of bad administration to which he had been privy; the many illegal patents he had been compelled to pass; and all this came full home to Buckingham, the great object of national vengeance. The faults, too, imputed to himself, he might have extenuated so far as to procure a great mitigation of the censure that must otherwise fall upon him in its utmost rigor. All this he foresaw and felt; but the king absolutely commanded him not to be present at his trial; promising on his royal word, to screen him in the last determination; or if that could not be, to reward him afterwards with ample retribution of protection and favor. He obeyed, and was undone.

State Tri. Vol. I. p. 353, etc.

On the twelfth of March, a committee for inspecting into the abuses of the courts of justice was appointed by the commons. Some days after, Sir Robert Phillips, a gentleman eminent for public spirit and humanity, reported from thence to the house, that complaints had been brought before them, by two persons, against the lord Chancellor, for bribery and corruption. This report he made not only without bitterness, but in terms of great regard and tenderness for the accused; moving that the business might be presented to the peers singly, and without exaggeration. At a conference, on the nineteenth, between certain members of both houses, the lords agreed to take the matter into their speedy consider-

ation. As soon as this affair was become the public talk, a new croud of accusers appeared, and charged home the unhappy chancellor with other and flagrant instances of bribery; such persons especially as had courted him with presents, and afterwards received a judgment unfavorable to their expectations: animated more by that disappointment, than by the iniquity of his decisions; for it does not appear that any of his decrees were ever reversed. He was all this while confined to his house by an indisposition, real or pretended: but if his body was in health, what must have been the condition of his mind, in this interval of suspense and anxiety? a great mind, already self-convicted, yet exquisitely sensible to good fame, which it has long enjoyed, and is upon the point of losing for ever! His reflections, whether he looked back on the past, or forward to the prospect before him, must have been terrible: as they were at the same time inflamed by peculiar circumstances of shame and confusion; that he was now, at the age of sixty-one, falling a victim to the rapine and insolence of his domestics, which he had weakly connived at, rather than to any faults of his own.

Rushworth's Col. Vol. I.

On the twenty-sixth of March, the king came to the house of peers; and, in expressions of studied popularity, owned the errors of his government exclaimed against the patents complained of, frankly gave up to justice the lesser criminals concerned in them: and all this for the sake of his favorite, whom in the end he endeavoured to screen by the poorest reasons imaginable. Indeed, no good reasons could be alledged in defence of him, who was the greatest criminal; and without whose concurrence the wretches in question could not have been guilty. The lords were not imposed upon by this speech; however, thinking it sufficient to have reduced their sovereign to the necessity of an apology, they feigned to be of his opinion. Thus, Buckingham escaped for the present; to accumulate new guilt, and to fall at last, ignobly, by a private hand: after he had been devoted, by the curses of a whole people, and more

solemnly still by the denunciations of their representatives. After a recess of three weeks, the house met again: but the weight of their indignation fell singly, and therefore without mercy, on the chancellor. They were not satisfied with his letter of general confession, though delivered to them by the prince of Wales; in which he renounced all justification of himself, and sued for no other favor, "but "that his penitent submission might be his sentence, "and the loss of the seals his punishment." He was obliged to put in a particular answer to every point of his accusation: which he did on the first of May, 1621; acknowledging, in the most explicit words, the corruption charged upon him in twenty-eight several articles, and throwing his cause entirely on the compassion of his judges. His sentence was, "to undergo a fine of forty thousand pounds; to be "imprisoned in the Tower during the king's plea-"sure; to be for ever uncapable of any office, place, "or employment in the commonwealth; and never "to sit again in parliament, or come within the verge "of the court." Thus he lost the great privilege of his peerage; a severity unusual, except in cases of treason and attainder.

The last article of his charge furnishes matter for much reflection. It alledges, "that he had given "way to great exactions in his servants, both in re-"spect of private seals, and otherwise for sealing in-"junctions." This indulgence to his domestics, which was certainly extreme, has been generally, and I believe truly, reckoned the principal cause of those irregularities that drew on his disgrace. Liberal in his own temper, or rather profuse beyond the condition of a man who means to preserve his integrity, he allowed his family in every kind of extravagance: and as many of his retinue were young, dissipated, giddy in the pursuit of pleasure, they squandered without measure, where they were indulged without control*.

Wilson. Bushel's Abridg. Post. p. 2.

* One day, during his trial, as he was passing through a room where several of his domestics were sitting, upon their getting up to salute him, Sit down, my masters, he cried; your rise hath been my fall.

Whether he did not discover this error till it was too late, or whether a soul like his, lost in the greatness and immensity of its own views, could not attend to that detail of little and disagreeable particulars, which yet œconomy requires; however that was, to support his ordinary train of living, he fell into corruption himself, and connived at it in his dependents. Thus we behold him, a memorable example of all that is great and exalted, of all that is little and low, in man. Such inconsistencies in our human nature cannot but alarm and terrify even those who are most confirmed in a habit of virtue.

After a short confinement in the Tower, the king restored him to his liberty, and forgave the fine in which the parliament had amerced him. As this fine was very considerable, he managed so as to have it assigned over to some of his friends, under the notion of being his creditors: and we find Williams, his successor in the seals, complaining heavily of this stratagem; as if he thereby intended to defraud those persons to whom he was really in debt, who were many and in danger of being ruined by his fall. But I am inclined to hope, that he made use of this artifice with a more innocent view: namely, to procure himself a short respite from their importunities, till he could settle his private affairs, extremely perplexed by former ill management, and now by the loss of his employments rendered desperate. That I may not be obliged to mention any more an affair alike ungrateful to the reader and writer, I will observe here, that about three years after this, he petitioned king James for a total remission of his censure: "to the end that this blot of ignominy might "be removed from him, and from his memory with "posterity." What lay in the king's power, James readily granted, a full and entire pardon of his whole sentence*. Posterity likewise, to which he appealed, has seemed unwilling to remember that he ever

Cabala, p. 263. Ed. 1691.

Bacon, Vol. V. Letter ccxciv. Cabala, p. 249.

* Accordingly he was summoned to the first parliament of king Charles.

offended: and those who record his failings, like those who have made observations on the spots in the sun, neither pretend to diminish his real brightness in himself, nor deny his universal influence on the world of learning. Thus he withdrew from the glare of a public station into the shade of retirement and studious leisure; often lamenting, that ambition and false glory had so long diverted him from the noblest as well as the most useful employments of a reasonable being: mortified, no doubt, into these sentiments by a severe conviction, in his own person, of the instability and emptiness of all human grandeur.

Bushel's Abridg. Post. p. 3.

Hitherto we have followed him through the bustle and obliquity of business. We shall find him henceforth in a more pleasing, though a less conspicuous situation; freed from the servitude of a court; from an intolerable attendance there, on the vices and follies of men every way his inferiors (for in this reign no one could rise to power on more honorable terms:) in a condition now to pursue the native bent of his genius; to live to himself, and for the advantage, not of one age, or one people only, but of all mankind, and all times to come.

An. 1622.

The first considerable work he engaged in, after his retirement, was the history of Henry the seventh; which he undertook at the desire of king James, and published in the year 1622. Whatever some writers may have insinuated of his melancholy and dejection, we find every where, in this performance, evident traces of a spirit unbroken by age, and unsubdued by misfortunes. It has been highly applauded, and as much condemned: a proof that it has more than common merit. And we may venture to affirm, that, whatever its faults are, they arise from no want of vigor in the understanding, or of warmth in the imagination of the writer. King James affected to consider his great grandfather Henry as a perfect model for the imitation of other monarchs: and as his was the reign of flattery, this quickly grew to be the prevalent and fashionable opinion at court. Though in

truth, that prince's character was, in every part of it, unamiable; and his conduct, on many occasions, weak or wicked. If my lord Bacon has not wholly escaped the infection of his age; if he has here and there attempted to brighten the imperfections, and throw in shades the bad features of the original he was drawing; yet, through these softenings, we can easily see this king as he was, and in all his genuine deformity. Suspicion and avarice, his own historian acknowledges, were the chief ingredients in his composition: and therefore his politics, both at home and abroad, were narrow, selfish, and false. Void of all great and extensive prudence, he endeavoured to supply that want by temporary shifts, and the little expedients of cunning. By these he commonly had the luck to extricate himself out of difficulties which a wiser man would have timely foreseen, and a better man have wholly prevented. But as his genius was unsociable and solitary, the darkness in his temper passed on mankind for depth and sagacity in his understanding. His avarice too, was sordid and shameless. Nothing seemed mean, nothing unjust in his eyes, that could fill his coffers: and merely to fill them, for of wealth he had no enjoyment, he descended to arts of rapine no less scandalous than they were oppressive. Bacon, Vol. V.

I have acknowledged that my lord Bacon's History has been taxed of partiality, and I will not dissemble that his style has been objected to, as full of affectation, full of false eloquence. But that was the vice, not of the man, but of the times he lived in: and particularly of a court, that, after the sovereign's example, delighted in the tinsel of wit and writing, in the poor ingenuity of punning and quibbling.

His Essays have, of all his works, been most current, and are still very justly esteemed. Towards the close of his life he greatly enlarged them both in number and weight; and published them anew, not only in English, but in a more universal language, which, he imagined, may preserve them as long as books shall last. As they are intended not to amuse

but instruct; as they are neither a satire on human nature, nor the school of scepticism; Monsieur de Voltaire observes, that they have been less popular than the maxims of Rochefoucault, or the Essays of Montagne. A remark that does my lord Bacon honor; who was too great a man to court a reputation from the multitude, by sacrificing to that malignity, or indulging that curious extravagance, which too many readers, I am afraid, expect to find gratified, even in writings of a moral kind.

Lettres sur les Anglois, p. 88.

Of the other works which he composed in this last scene of his life, I forbear to make mention here: they will be all enumerated in another place. Let me only observe, that nothing can give a more exalted idea of the fruitfulness and vigour of his genius, than the number and nature of those writings. Under the discouragement of a public censure, broken in his health, broken in his fortunes, he enjoyed his retirement not above five years: a little portion of time! yet he found means to crowd into it what might have been the whole business, and the glory too, of a long and fortunate life. Some of his former pieces he methodized and enriched; several new ones he composed, no less considerable for the greatness and variety of the arguments he treated, than for his manner of treating them. Nor are they works of mere erudition and labor, that require little else but strength of constitution and obstinate application: they are original efforts of genius and reflection, on subjects either new, or handled in a manner that makes them so. His notions he drew from his own fund; and they were solid, comprehensive, systematical; the disposition of his whole plan throwing light and grace on all the particular parts. In considering every subject, he seems to have placed himself in a point of view so advantageous and elevated, that he could from thence discover a whole country round him, and mark out the several spots of it, distinctly and with ease. These characters are equally due to the works in which he made some progress, and to those he could only attempt.

His supposed poverty has been much insisted on, not only by our own writers, but by foreigners. Some of the former have asserted, that he languished out a solitary being in obscurity and indigence: and among the latter, Le Clerc, who was led into the same notion by a passage in one of Howel's letters, has animadverted with an honest indignation on the meanness of that prince, who could leave such a man as he was, to struggle, in his declining age, both with penury and affliction. I believe the matter has been exaggerated. Perhaps he did not enjoy affluence or entire ease of fortune: but his ordinary income must have placed him above sordid want and anxiety. Dr. Rawley, who lived long in his family, affirms that the king had given him, out of the Broad Seal and Alienation office, to the value of eighteen hundred pounds a year; which, with his own lands, amounting to a third part more, he retained to his death. But then he had treasured up nothing in his prosperous condition against the day of adversity: and his pension was not only precarious, but ill paid, by a king, who, instead of husbanding his revenues for great or good purposes, was daily lavishing them away, in fruitless negociations, or on the least deserving of his subjects. Add to these things, that my lord Bacon lay all this time under the incumbrance of a vast debt; and that he had doubtless expended very considerable sums in procuring or making experiments. Even those, whom we see close and sparing on every other occasion, are yet profuse in gratifying a favorite passion. From all which arose that distress and those difficulties into which he was often plunged. That they were many and great, we can entertain no doubt*. It is but too strongly confirmed to us by some unusual expressions in his letters to king James; where we find him pouring out his heart in complaints and supplications of such a strain, as every one who reveres his Wilson.

* It appears by a letter of Buckingham to him, that he asked for the provostship of Eton college, and was refused it.

Bacon, Vol. V. Letter CCLXXVI.

memory will wish he had never uttered. Those who insist on the meanness, those who plead for the dignity, of human nature, may, in this one man, find abundant matter to support their several opinions. But, let us draw a veil over imperfections, and at the same time acknowledge, that a very ordinary penetration may serve to discover remarkable blemishes and failings in the most comprehensive minds, in the greatest characters, that ever adorned mortality.

An. 1625. King James died in 1625; after an inglorious and a fatal reign of three and twenty years: despised by foreigners, despised and hated by his own subjects. The mischievous notions he broached, the perverse conduct he held, gave rise to those divisions that quickly after involved his kingdoms in all the guilt and misery of a civil war: that shook the British constitution to its foundations, and in the end overturned it; tho' apparently framed to last for ages, as it had been ages in building up and perfecting.

His unfortunate chancellor survived him something above a year. The multiplicity of business and study in which he had been long engaged, but above all the anguish of mind he secretly laboured under, had undermined and broken into his health. After having been for some time infirm and declining, he owed his death at last to an excess, not unbecoming a philosopher; in pursuing, with more application than his strength could bear, certain experiments touching the conservation of bodies. He was so suddenly struck in his head and stomach, that he found himself obliged to retire into the earl of Arundel's house at Highgate, near which he then happened to be. There he sickened of a fever, attended with a defluxion on his breast; and, after a week's

An. 1626. illness, expired; on the ninth of April, in the sixty-sixth year of his age. How he bore this indisposition, or what discourses he held at the nearer approaches of death, no account is to be found; an omission which every reader must feel and regret: as nothing can awaken the attention, nothing affect the heart of man more strongly than the behaviour of

eminent personages in their last moments; in that only scene of life wherein we are all sure, later or sooner, to resemble them. There remains only a letter, the last he ever wrote, addressed to that nobleman under whose roof he died; in which he compares himself to a celebrated philosopher of antiquity, Pliny the elder; who lost his life by inquiring, with too dangerous a curiosity, into the first great eruption of Vesuvius. Bacon, Vol. V. Letter ccc.

Thus lived and died the lord chancellor Bacon*.

He was buried privately in St. Michæl's church near St. Alban's. The spot that contains his remains lay obscure and undistinguished, till the gratitude of a private man, formerly his servant, erected a monument to his name and memory. In another country, in a better age, his monument would have stood a public proof in what veneration the whole society held a citizen, whose genius did them honor, and whose writings will instruct their latest posterity. Sir Thomas Meautys.

One passage in his will is remarkable. After bequeathing his soul and body in the usual form, he adds, "my name and memory I leave to foreign "nations; and to mine own countrymen, after some Baconiana, p. 203.

* He continued single till after forty, and then took to wife a daughter of alderman Barnham, of London, with whom he received a plentiful fortune, but had by her no children: and she out-lived him upwards of twenty years. Such readers as have any curiosity to know what regimen he observed, may take the following account of it in the words of his chaplain. "His diet was rather plentiful "and liberal than restrained. In his younger years he was much "given to the finer and lighter sorts of meats: but afterwards he "preferred the stronger, such as the shambles afforded; as those "which bred the more firm and substantial juices, and less dissi-"pable. He did not, you may be sure, neglect that himself, which "he so much extolled to others in his writings, the frequent use of "nitre; whereof he took the quantity of about three grains in thin "warm broth every morning, for thirty years together. His ordi-"nary physic was a maceration of rhubarb, infused into a draught "of white wine and beer mingled together for the space of half an "hour, once in six or seven days, immediately before his meal, "whether dinner or supper; that it might dry the body less. His "receipt for the gout, which constantly gave him ease within two "hours, is set down in the end of the Natural History." See Vol. II.

" time be passed over." As to the former, he was, even in his life-time, looked upon with admiration by the most eminent men that France and Italy could then boast of; and by some of them visited, as one whose talents were an ornament, not only to his age, but to human nature itself. When the marquis D'Effiat brought into England the princess Henrietta-Maria, wife to Charles the first, he paid a visit to my lord Bacon; who, being then sick in bed, received him with the curtains drawn. " You re-
" semble the angels, said that minister to him: we
" hear those beings continually talked of, we believe
" them superior to mankind, and we never have the
" consolation to see them." Among his countrymen, the names, alone, of those who have adopted his notions, and proceeded on his plan, are his highest encomium. To pass over a long line of philosophers, all illustrious; he reckons in the list of his followers a Boyle, a Locke, a Newton himself.

Voltaire, Lettres sur les Anglois, p. 82.

Rawley's Life of Bacon.

One singularity there was in his temperament, not easily to be accounted for: in every eclipse of the moon, whether he observed it or not, he was certainly seized with a sudden fit of fainting; which left him, without any remaining weakness, as soon as the eclipse ended. He was of a middling stature; his forehead spacious and open, early impressed with the marks of age; his eye lively and penetrating; his whole appearance venerably pleasing: so that the beholder was insensibly drawn to love, before he knew how much reason there was to admire him. In this respect, we may apply to my lord Bacon what Tacitus finely observes of his father in law, Agricola: a good man you would readily have judged him to be, and been pleased to find him a great man.

Evelyn of Medals, p. 340.

Those talents that commonly appear single in others, and they too men of reputation, shone forth in him united and eminent. All his cotemporaries, even those who hated the courtier, stand up and bear witness together to the superior abilities of the writer and pleader, of the philosopher and companion. In conversation he could assume the most differing cha-

Osborn's Advice to a Son.

racters, and speak the language proper to each, with a facility that was perfectly natural; or the dexterity of the habit concealed every appearance of art: a happy versatility of genius which all men wish to arrive at, and one or two, once in an age, are seen to possess. In public, he commanded the attention of his hearers, and had their affections wholly in his power. As he accompanied what he spoke with all the expression and grace of action, his pleadings, that are now perhaps read without emotion, never failed to awaken in his audience the several passions he intended they should feel. This is not a picture of him drawn from fancy: it is copied, and that but in miniature, after another taken by one who knew him well; a good judge of merit, and seldom known to err, at least in heightening a favorable likeness. As a philosopher, it is scarce hyperbolical to say of him, in Mr. Addison's words, that he had the sound, distinct, comprehensive knowledge of Aristotle, with all the beautiful lights, graces, and embellishments of Cicero. To this commendation of his talents, the learned throughout Europe have given their common sanction, and own him for the father of the only valuable philosophy, that of fact and observation.

B. Johnson, in his Discoveries.

It remains then to consider him, more particularly than we have hitherto done, in this most known and conspicuous part of his character; where his merit is unquestionably great and intirely his own. For, to the writings of the ancients he was not, he could not, be obliged. They had either mistaken the right road to natural knowledge; or if any of them struck into it by chance, finding the way difficult, obscure, and tedious, they soon abandoned it for ever. He owed to himself alone, to a certain intellectual sagacity, that beam of true discernment which shewed him at once, and as it were by intuition, what the most painful inquirers, for more than twenty ages backward, had searched after in vain. And here let me observe towards him the same impartiality I have hitherto aimed at: and, in order to know what he really did as a philosopher, place before the reader a

short view of the state of learning in Europe, from the dark period of Gothicism down to the sixteenth century. But let me at the same time acknowledge, that this account will be only a rude and imperfect sketch: consisting of a few detached particulars, without much order or method.

Although the great era of ignorance has been fixed, justly enough, to those times when the northern nations, like a mighty inundation, overspread the face of Europe; yet it is no less certain that barbarism and corruption were entered into arts and sciences ere the savages had made any impression on the Roman empire. Under them indeed, that darkness which had been long growing on the world, and gradually extinguishing every light of knowledge, soon became total, and threatened to be perpetual. In the eighth century, we find that the highest ambition of the clergy was to vie with one another in chanting the public service, which yet they hardly understood. This important emulation run so high between the Latin and French priesthood, that Charlemagne, who was then at Rome, found it necessary to interpose, and decide the controversy in person. The monk, who relates this affair with a most circumstantial exactness, adds, that the emperor intreated pope Adrian to procure him certain persons, who might teach his subjects the first principles of grammar and arithmetic; arts that were then utterly unknown in his dominions. This warlike monarch, though his own education had been so far neglected that he had never learned to write, discovered, by his natural good sense, the value of knowledge, and set himself to be its promoter and patron. He even allowed a public school to be opened in the imperial palace, under the direction of our famous countryman Alcuin; on whom he chiefly relied for introducing into France some tincture of that philosophy which was still remaining in Britain. But how slow and ineffectual the progress of any learning must have been, we may guess from an edict of the council of Challons, in the next century; which earnestly

An. 787.

Joannis Launoii Op. t. iv. p. 2.

813.

exhorts all monasteries to be careful in having their manuals of devotion correctly transcribed: lest, while they piously mean to ask of God one thing, some inaccurate manuscript may betray them into praying for the quite contrary. Launoii, p. 3.

As to Britain, if learning had still some footing there in the eighth century, it was so totally exterminated from thence in the ninth; that, throughout the whole kingdom of the West-Saxons, no man could be found who was scholar enough to instruct our king Alfred, then a child, even in the first elements of reading: so that he was in his twelfth year before he could name the letters of the alphabet. When that renowned prince ascended the throne, he made it his study to draw his people out of the sloth and stupidity in which they lay: and became, as much by his own example, as by the encouragement he gave to learned men, the great restorer of arts in his dominions. And here we are called upon to observe, that as France had been formerly obliged to England in the person of Alcuin, who planted the sciences there under Charlemagne; our island now received the same friendly assistance from thence by Grimbald, whom king Alfred had invited hither, and made chancellor of Oxford. Such events as these are too considerable, in the literary history of the ninth age, to be passed over unobserved. The rise of a noted grammarian, the voyage of an applauded doctor, are recorded by the chroniclers of that century, with the same reverence that an ancient writer would mention the appearance of a Lycurgus, or a Timoleon; of a lawgiver who new-models a state, or a hero who rescues a whole people from slavery. Hist. et antiq. univer. Oxon. p. 13. 879.

But these fair appearances were of short duration. A night of thicker darkness quickly overspread the intellectual world: and in the moral, followed a revolution still more deplorable. To common sense and piety, succeeded dreams and fables, visionary legends and ridiculous penances. The clergy, now utter strangers to all good learning, instead of guiding

a rude and vicious laity by the precepts of the gospel, which they no longer read, amused them with forged miracles, or overawed them by the ghostly terrors of demons, spectres and chimeras. This was more easy, and more profitable too, than the painful example of a virtuous life. The profound depravity that was spread through all conditions of men, ecclesiastic and secular, appears in nothing more plain than in the reasons assigned for calling several councils about this time. In one, new canons were to be made, forbidding adultery, incest, and the practice of pagan superstitions: as if these things had not till then been accounted criminal. In another, it was found necessary to declare, that a number of angels worshipped universally under certain names were altogether unknown: and that the church could not warrant the particular invocation of more than three. A third, which the empress Irene had summoned for the reformation of discipline, ordained, that no prelate should thenceforth convert his episcopal palace into a common inn; nor in consideration only of any sum of money given him by one man, curse and excommunicate another. A fourth and fifth censure the indecency of avowed concubinage: and enjoin that friers and nuns should no longer converse or live promiscuously in the same convent.

Giannone, Istor. di Napoli, l. 5.

The see of Rome, which should have been a pattern to the rest, was of all christian churches the most licentious*; and the pontifical chair often filled with

* The book intitled, *The tax of the Roman Chancery*, published first at Rome, in the year 1514, furnishes us with a flagrant instance of this in the following passage, which I choose not to translate. "Absolûtio à lapsu carnis super quocunque actu libidinoso commisso "per *Clericum*, etiam cum *monialibus*, intra et extra septa monasterii; "aut cum *consanguineis* vel affinibus, aut filia spirituali, aut quibusdam aliis, sive ab unoquoque de per se, sive simul ab omnibus "absolutio petatur, cum *dispensatione* ad *ordines* et *beneficia*, cum "inhibitione, tur. 36, duc. 3. Si vero cum illis petatur, *absolutio* "etiam a crimine commisso *contra naturam*, vel cum *brutis*, cum "dispensatione, ut supra, et cum inhibitione, tur. 90, duc. 12, "carl. 16. Si vero petatur tantum absolutio a crimine *contra naturam*, "vel cum *brutis*, cum dispensatione et inhibitione, turon. 36, duc. "9. Absolutio pro *Moniali*, quae se permisit *pluries* cognosci

men, who, instead of adorning their sacred character, made human nature itself detestable: a truth by many catholic writers acknowledged and lamented. Several popes were by their successors excommunicated, their acts abrogated, and the sacraments administered by them pronounced invalid. No less than six were expelled by others who usurped their seat; two were assassinated: and the infamous Theodora, infamous even in that age, by her credit in the holy city obtained the triple crown for the most avowed of her gallants, who assumed the name of John the tenth. Another of the same name was called to govern the christian world at the age of twenty one; a bastard son of Pope Sergius who died eighteen years before. If such were the men who arrogated to themselves titles and attributes peculiar to the Deity, can we wonder at the greatest enormities among lay-men? Their stupidity kept pace with the dissolution of their manners, which was extreme: they still preserved, for the very clergy we have been speaking of, a reverence they no longer had for their God. The most abandoned among them, miscreants, familiar with crimes that humanity startles at, would yet, at the hazard of their lives, defend the immunities of a church, a consecrated utensil, or a donation made to a convent. In such times as those, it were in vain to look for useful learning and philosophy. Not only the light of science, but of reason, seems to have been well-nigh extinguished.

Idem, l. 7.

John XI.

It was not till late, after the sack of Constantinople by the Turks, that the writings of Aristotle began to be universally known and studied. They were then, by certain fugitive Greeks, who had escaped the fury of the Ottoman arms, brought away and dispersed through the Western parts of Europe. Some particular treatises of his, it is true, had been long

An. 1453.

" intra et extra septa monasterii, cum *rehabilitate* ad *dignitates* illius " ordinis, etiam *abbatialem*, turon. 36, duc. 9." In the edition of Bois-le-duc, there is "Absolutio pro *eo*, qui *interfecit* patrem, matrem, " sororem, uxorem . . . . g. 5, vel 7." Vide Bayle, art. BANCK.

made public; but chiefly in translations from the Arabic, done by men who, far from rendering faithfully the author's sense, hardly understood his language. These however gave birth to the scholastic philosophy; that motley offspring of error and ingenuity; and to speak freely, the features of both parents were all along equally blended in the complexion of the daughter. To trace at length the rise, progress, and variations of this philsophy, would be an undertaking not only curious but instructive, as it would unfold to us all the mazes in which the force, the subtlety, the extravagance of human wit can lose themselves: till not only profane learning but divinity itself was at last, by the refined frenzy of those who taught both, subtilized into mere notion and air.

Their philosophy was neither that of Aristotle entirely, nor altogether differing from his. Whatever opinions the first founders of it had been able to draw, from Boetius his Latin commentator, or from the wretched translations above-mentioned, these they methodized and illustrated, each according to his several talent, and the genius of the age he lived in. But this, instead of producing one regular and consistent body of science, even from wrong principles, ended in a monster, made up of parts every where mishapen and dissimilar. Add to this, that they left natural knowledge wholly uncultivated; to hunt after occult qualities, abstract notions, and questions of impertinent curiosity, by which they rendered the very logic their labours chiefly turned upon intricate, useless, unintelligible.

Alstedius, in his chronology of the schoolmen, has divided their history into three principal periods or
An. 1050. successions: the first beginning with Lanfranc, archbishop of Canterbury, who flourished about the middle of the eleventh century; and ending with Albert the
An. 1320. Great two ages later: the second, that commences from him, determining in Durand; as the third and last ended in Luther, at the reformation. Morhoff,
Polyhistor. Tom. II. p. 73, etc. however, strenuously contends, that Rucelinus, an

Englishman, was properly the father of the schoolmen: and that to him the sect of the Nominalists owed its rise and credit. He adds, that it revived afterwards in the person of Occam, another of our countrymen, and the perpetual antagonist of Duns Scotus, who had declared for the Realists, and was reckoned their ablest champion. The learned reader needs not be told, that the scholastic doctors were all distinguished into these two sects; formidable party-names which are now as little known or mentioned as the controversies that once occasioned them. It is sufficient to say, that, like all other parties, they hated each other heartily; treated each other as heretics in logic: and that their disputes were often sharp and bloody; ending not only in the metaphorical destruction of common sense and language, but in the real mutilation and death of the combatants. For, to the disgrace of human reason, mankind in all their controversies, whether about a notion or a thing, a predicament or a province, have made their last appeal to brute force and violence. The titles * with which these leaders were honored by their followers, on account of the sublime reveries they taught, are at once magnificent and absurd: and prove rather the superlative ignorance of those times, than any transcendent merit in the men to whom they were applied. From this censure we ought nevertheless to except one, who was a prodigy of knowledge for the age he lived in, and is acknowledged as such by the age to which I am writing. I mean the renowned frier Bacon, who shone forth singly through the profound darkness of those times; but rather dazzled than enlightened the weaker eyes of his cotemporaries. As if the name of Bacon were auspicious to philosophy, this man, not only without assistance or encouragement, but insulted and persecuted, by the unconquerable force of his genius

* The profound, the subtile, the marvellous, the indefatigable, the irrefragable, the angelic, the seraphic, the fountain of life, light of the world, *etc.*

penetrated far into the mysteries of nature, and made so many new discoveries in astronomy and perspective, in mechanics and chemistry, that the most sober writers even now cannot mention them without some marks of emotion and wonder. It is Dr. Freind's observation, that he was almost the only astronomer of his age: and the reformation of the calendar, by him attempted and in a manner perfected, is a noble proof of his skill in that science. The construction of spectacles, of telescopes, of all sorts of glasses that magnify or diminish objects, the composition of gunpowder (which Bartholdus Swartz is thought to have first hit upon almost a century later) are some of the many inventions with justice ascribed to him. For all which, he was in his life-time calumniated, imprisoned, oppressed: and after his death wounded in his good name, as a magician who had dealt in arts, infernal and abominable. He tells us, that there were but four persons then in Europe who had made any progress in the mathematics; and in chemistry yet fewer: that those who undertook to translate Aristotle were every way unequal to the task; and that his writings, which, rightly understood, Bacon considered as the fountain of all knowledge, had been lately condemned and burned, in a synod held at Paris.

The works of that celebrated ancient have, in truth, more exercised the hatred and admiration of mankind, than those of all the other philosophers together: Launoy enumerates no less than thirty-seven fathers of the church who have stigmatized his name, and endeavoured to reprobate his doctrines. Morhoff has reckoned up a still greater number of his commentators, who were at the same time implicitly his disciples; and yet both these authors are far from having given a complete list either of his friends or enemies. In his life-time he was suspected of irreligion, and, by the pagan priesthood, marked out for destruction: the successors of those very men were his partizans and admirers. His works met with much the same treatment from the christian

Lib. de varia Arist. fortuna, Tom. IV.

Polyhistor. Tom. II.

clergy: sometimes proscribed for heretical; sometimes triumphant and acknowledged the great bulwark of orthodoxy. Launoy has written a particular treatise on the subject, and mentioned eight different revolutions in the fortune and reputation of Aristotle's philosophy. To pass over the intermediate changes, I will just mention two, that make a full and ridiculous contrast. In the above-mentioned council held at Paris about the year 1209, the bishops there censured his writings, without discrimination, as the pestilent sources of error and heresy; condemned them to the flames, and commanded all persons, on pain of excommunication, not to read, transcribe, or keep any copies of them. They went farther, and delivered over to the secular arm no less than ten persons, who were burned alive, for certain tenets, drawn, as those learned prelates had heard, from the pernicious books in question. In the sixteenth century, those very books were not only read with impunity, but every where taught with applause: and whoever disputed their orthodoxy, I had almost said their infallibility, was persecuted as an infidel and miscreant. Of this the sophister Ramus is a memorable instance. Certain animadversions of his on the peripatetic philosophy occasioned a general commotion in the learned world. The university of Paris took the alarm hotly, and cried out against this attempt as destructive of all good learning, and of fatal tendency to religion itself. The affair was brought before the parliament; and appeared of so much consequence to Francis the First, that he would needs take it under his own immediate cognisance. The edict is still extant, which declares Ramus insolent, impudent, and a lyar. His books are thereby for ever condemned, suppressed, abolished: and what is a strain of unexampled severity, the miserable author is solemnly interdicted from transcribing, even from reading his own compositions!

Launoii, ubi supra.

Launoii, tom. IV. p. 206.

10th of May, An. 1543.

We might from hence be led to imagine, that when the authority of an ancient philsopher was held so sacred, philosophy itself must have been thoroughly

understood, and cultivated with uncommon success; but the attachment of those doctors was to a name, not to truth, or valuable science: and our author very justly compares them to the olympic wrestlers, who abstained from necessary labors, that they might be fit for such as were not so. Under their management, it was a philosophy of words and notions, that seemed to exclude the study of nature; that, instead of inquiring into the properties of bodies, into the laws of motion by which all effects are produced, was conversant only in logical definitions, distinctions, and abstractions, utterly barren and unproductive of any advantage to mankind. The great aim of those solemn triflers was rather to perplex a dispute, than to clear up any point of useful disquisition; to triumph over an enemy, than to enlarge the knowledge, or better the morals of their followers. So that this captious philosophy was a real obstacle to all advances in sound learning, human and divine. After it had been adopted into the christian theology, far from being of use to explain and ascertain mysteries, it served to darken and render doubtful the most necessary truths; by the chicanery of argumentation with which it supplied each sect, in defence of their peculiar and favorite illusions. To so extravagant a height did they carry their idolatry of Aristotle, that some of them discovered, or imagined they discovered in his writings, the doctrine of the Trinity; that others published formal dissertations to prove the certainty of his salvation, though a heathen: and that a patriarch of Venice is said to have called up the devil expressly, in order to learn from him the meaning of a hard word in Aristotle's Physics. But the crafty demon, who perhaps did not understand it himself, answered in a voice so low and inarticulate, that the good prelate knew not a word he said. This was the famous Hermolaus Barbaro: and the Greek word, that occasioned his taking so extraordinary a step, is the Entelechia of the Peripatetics; from whence the schoolmen raised their substantial forms, and which

Bacon's Apotheg.

Bayle, art. BARBARO.

Leibnitz, towards the end of the last century, attempted to revive in his theory of motion.

The reformation itself, that diffused a new light over Europe, that set men upon inquiring into errors and prepossessions of every kind, served only to confirm the dominion of this philosophy: protestants as well as papists entrenching themselves behind the authority of Aristotle, and defending their several tenets by the weapons with which he furnished them. This unnatural alliance of theology with the peripatetic doctrines rendered his opinions not only venerable but sacred: they were reckoned as the land marks of both faith and reason, which to pull up or remove would be daring and impious. Innovations in philosophy, it was imagined, would gradually sap the very foundations of religion, and in the end lead to downright atheism. If that veil of awful obscurity, which then covered the face of nature, should be once drawn; the rash curiosity of mankind would lead them to account for all appearances in the visible world, by second causes, by the powers of matter and mechanism: and thus they might come insensibly to forget or neglect the great original cause of all. This kind of reasoning convinced the multitude, over-awed the wiser few, and effectually put a stop to the progress of useful knowledge.

Such, in general, were the dispositions of mankind when Sir Francis Bacon came into the world; whom we will not consider as the founder of a new sect, but as the great assertor of human liberty; as one who rescued reason and truth from the slavery in which all sects alike had, till then, held them. As a plausible hypothesis, a shining theory, are more amusing to the imagination, and a shorter way to fame, than the patient and humble method of experimenting, of pursuing nature through all her labyrinths by fact and observation; a philosophy built on this principle, could not, at first, make any sudden or general revolution in the learned world. But its progress, like that of time, quiet, slow, and sure,

has in the end been mighty and universal. He was not however the first among the moderns who ventured to dissent from Aristotle. Ramus, Patricius, Bruno, Severinus, to name no more, had already attacked the authority of that tyrant in learning, who had long reigned as absolutely over the opinions of men, as his restless pupil had of old affected to do over their persons. But these writers invented little that was valuable themselves, however justly they might reprehend many things in him. And as to the real improvements made in some parts of natural knowledge before our author appeared, by Gilbert, Harvey, Copernicus, father Paul, and some few others, they are well known, and have been deservedly celebrated. Yet there was still wanting one great and comprehensive plan, that might embrace the almost infinite varieties of science, and guide our inquiries aright in all. This Sir Francis Bacon first conceived, in its utmost extent; to his own lasting honor, and to the general utility of mankind. If we stand surprised at the happy imagination of such a sytem, our surprise redoubles upon us when we reflect, that he invented and methodized this system, perfected so much, and sketched out so much more of it, amidst the drudgery of business and the civil tumults of a court. Nature seems to have intended him peculiarly for this province, by bestowing on him with a liberal hand all the qualities requisite: a fancy voluble and prompt to discover the similitudes of things; a judgment steady and intent to note their subtlest differences; a love of meditation and inquiry; a patience in doubting; a slowness and diffidence in affirming; a facility of retracting; a careful anxiety to plan and dispose. A mind of such a cast, that neither affected novelty, nor idolized antiquity, that was an enemy to all imposture, must have had a certain congeniality and relation to truth. These characters, which, with a noble confidence, he has applied to himself, are obvious and eminent in his Instauration of the Sciences: a work by him designed, not as a monument to his

own fame, but a perpetual legacy to the common benefit of others. He has divided the whole of it into six capital parts; with a short account of which we shall close this imperfect relation of his life and writings.

1. The first part of this Instauration proposes a general survey of human knowledge: and this he executed in that admirable treatise, intitled, The Advancement of Learning. As he intended to raise a new and lasting structure of philosophy, founded not in arbitrary opinions or specious conjectures, but in truth and experience; it was absolutely necessary to his design, first to review accurately the state of learning as it then stood, through all its provinces and divisions. To do this effectually required, with an uncommon measure of knowledge, a discernment not only exquisite but universal: the whole intellectual world was subjected to its examination and censure. That he might not lose himself on a subject so vast and of such variety; he has, according to the three faculties of the soul, memory, fancy, understanding, ranged the numerous train of arts under three great classes, history, poetry, philosophy. These may be considered as the principal trunks from which shoot forth, in prodigious diversity, the lesser parts and branches of science. Whatever is deficient, erroneous, or still wanting in each, he has pointed out at large: together with the properest means for amending the defects, for rectifying the errors, and for supplying the omissions in all. Upon the whole, he was not only well acquainted with every thing that had been discovered in books before his time, and able to pronounce critically on those discoveries: he saw clearly, and at the end of this treatise has marked out in one general chart, the several tracts of science that lay still neglected or unknown. And to say truth, some of the most valuable improvements since made have grown out of the hints and notices scattered through this work: from which the moderns have selected, each according to his fancy, one or more plants to cultivate and bring to perfection.

De augmentis, scientiarum.

Novum Organon.

2. The design of the Novum Organon, which stands as the second part to his Instauration, and may be reckoned the most considerable, was to raise and enlarge the powers of the mind, by a more useful application of its reasoning faculty to all the different objects that philosophy considers. In this place, our author offers to the world a new and better logic; calculated not to supply arguments for controversy, but arts for the use of mankind; not to triumph over an enemy by the sophistry of disputation, but to subdue nature itself by experiment and inquiry. As it differs from the vulgar logic in its aim, it varies no less from that captious art in the form of demonstrating: for it generally rejects syllogism, as an instrument rather hurtful than serviceable to the investigation of nature, and uses in its stead a severe and genuine induction. Not the trivial method of the schools, that, proceeding on a simple and superficial enumeration, pronounces at once from a few particulars, exposed to the danger of contradictory instances: but an induction that examines scrupulously the experiment in question, views it in all possible lights, rejects and excludes whatever does not necessarily belong to the subject; then, and not till then, concluding from the affirmatives left. A croud of instances might be brought to shew how greatly this method of inquiry has prospered in the hands of the moderns; and how fruitful it has been of new discoveries, unknown and unimagined by antiquity. But I will only mention one that may stand in place of many; the Optics of our immortal Newton: where, in a variety of experiments, he has analysed the nature and properties of light itself, of the most subtile of all bodies, with an accuracy, a precision, that could hardly ha.e been expected from examining the grossest and most palpable. From whence, by the method of induction, he has raised the noblest theory that any age or country can shew.

Phænomena universi.

3. It has been the fate of almost every considerable scheme for the good of mankind to be treated,

at first, as visionary, or impracticable, merely for being new. This our author foresaw, and endeavoured to obviate, in the third part of his Instauration; by furnishing materials himself towards a natural and experimental history; a work which he thought so indispensably necessary, that without it the united endeavours of all mankind, in all ages, would be insufficient to rear and perfect the great structure of the sciences. He was aware too, that even men of freer and more extensive notions, who relished his new logic, might be deterred from reducing it to practice, by the difficulties they would meet with in experimenting, according to the rules by him prescribed. He therefore led the way to other inquires in his *Sylva Sylvarum*, or history of nature: which, however imperfect in many respects, ought to be looked upon as extensive and valuable for that age, when the whole work was to be begun. This collection, which did not appear till after his death, has been generally considered as detached from, and independent on his general plan: and therefore his design in making and recording these experiments has not been duly attended to by the reader. They are a common repository or store-house of materials, not arranged for ornament and show, but thrown loosely together for the service of the philosopher: who may from thence select such as fit his present purpose; and with them, by the aid of that organ or engine already described, build up some part of an axiomatical philosophy, which is the crown and completion of this system. The phænomena of the universe he ranges under three principal divisions; the history of generations, or the production of all species according to the common laws of nature; that of preter-generations, or of births deviating from the stated rule; and thirdly, the history of nature as confined or assisted, changed or tortured by the art of man; which last discloses to us a new face of things, and as it were another world of appearances. The use of such a history he reckons two-fold; either the knowledge of qualities in themselves: or to serve for the

Bacon. Vol. VIII.

first matter of a true and useful philosophy. With this view only did our author make and gather together the miscellaneous collection I am speaking of. That many particular experiments have been found doubtful or false, cannot be wondered at: the whole was then a tract of science uncultivated and desert. If several considerable men, treading in the path he struck out for them, have gone farther and surveyed it more exactly than he did, yet to him is the honor of their discoveries in a manner due. It was Columbus alone who imagined there might be a new world; and who had the noble boldness to go in search of it, through an ocean unexplored and immense. He succeeded in the attempt; and led his followers into a spacious continent, rich and fruitful. If succeeding adventurers have penetrated farther than he into its several regions, marked out and distinguished them with more accuracy; the result of these discoveries has less extended their fame than it has raised and enlarged his.

Scala Intellectus.

4. After these preparations, nothing seems wanting but to enter at once on the last and most exalted kind of philosophy: but the author judged, that in an affair so complicated and important, some other things ought to precede, partly for instruction, and partly for present use. He therefore interposed a fourth and fifth part. the former of which he named *Scala Intellectus*, or a series of steps by which the understanding might regularly ascend in its philosophical researches. For this purpose he proposed examples of inquiry and investigation, agreeable to his own method, in certain subjects; selecting such especially as are of the noblest order, and most widely differing from one another, that instances of every sort might not be wanting. The fourth part then was to contain a particular application and illustration of the second. In this light we choose to consider the six monthly histories which he proposed to write on six principal topics in natural history: namely, of winds; of life and death; of rarefaction and condensation; of the three chemical principles, salt, sul-

phur, mercury; of bodies heavy and light; of sympathy and antipathy. The first three, in the order I have here placed them, he prosecuted at some length; and in a manner that shews with what a happy sagacity he could apply his own rules to the interpretation of nature. The wonder is, that other inquirers since his time have done so little towards perfecting the two first mentioned, things of so great concern to human society, and to every individual. As to the three last, we have only a short introduction to each: death having prevented him from writing any thing on the subjects themselves. Such is our condition here: whoever is capable of planning useful and extensive schemes dies always too soon for mankind, even in the most advanced age.

5. Of the fifth part he has left nothing but the title and scheme. It was indeed to be only a temporary structure, raised with such materials as he himself had either invented, or tried, or improved; not according to the due form of genuine induction, but by the same common use of the understanding that others had employed. And this was to remain no longer than till he had raised, Anticipationes philos. secundæ.

6. The sixth and sublimest part of this grand Instauration, to which all the precedent are merely subservient; a philosophy purely axiomatical and scientific; flowing from that just, castigated, genuine manner of inquiry, which the author first invented and applied. But this he despaired of being able to accomplish; and the learned of all countries from his days have been only laboring some separate or lesser parts of this amazing edifice, which ages to come may not see finished according to the model left them by this one man. Philosophia prima, sive activa.

Such, and so unlimited were his views for the universal advancement of science; the noble aim to which he directed all his philosophic labors. What Cæsar said, in compliment to Tully, may, with strict justice, be applied to him; that it was more glorious to have extended the limits of human wit, than to have enlarged the bounds of the Roman world. Sir

Francis Bacon really did so: a truth acknowledged not only by the greatest private names in Europe, but by all the public societies of its most civilized nations. France, Italy, Germany, Britain, I may add even Russia, have taken him for their leader, and submitted to be governed by his institutions. The empire he has erected in the learned world is as universal as the free use of reason: and one must continue, till the other is no more.

PHILOSOPHICAL WORKS.

THE

TWO BOOKS

OF

FRANCIS BACON,

OF THE

PROFICIENCE AND ADVANCEMENT

OF

LEARNING,

DIVINE AND HUMAN.

TO THE KING.

PHILOSOPHICAL WORKS.

THE

FIRST BOOK OF FRANCIS BACON:

OF THE

PROFICIENCE AND ADVANCEMENT

OF

LEARNING, DIVINE AND HUMAN.

TO THE KING.

THERE were under the law, excellent king, both daily sacrifices, and freewill offerings: the one proceeding upon ordinary observance, the other upon a devout chearfulness: in like manner there belongeth to kings from their servants, both tribute of duty, and presents of affection. In the former of these, I hope I shall not live to be wanting, according to my most humble duty, and the good pleasure of your majesty's employments: for the latter, I thought it more respective to make choice of some oblation, which might rather refer to the propriety and excellency of your individual person, than to the business of your crown and state.

Wherefore representing your majesty many times unto my mind, and beholding you not with the inquisitive eye of presumption, to discover that which the Scripture telleth me is inscrutable, but with the observant eye of duty and admiration: leaving aside the other parts of your virtue and fortune, I have been touched, yea, and possessed with an extreme wonder at those your virtues and faculties, which the philosophers call intellectual: the largeness of your capacity, the faithfulness of your memory, the swiftness of your apprehension, the penetration of your

judgment, and the facility and order of your elocution: and I have often thought, that of all the persons living that I have known, your majesty were the best instance to make a man of Plato's opinion, that all knowledge is but remembrance, and that the mind of man by nature knoweth all things, and hath but her own native and original notions (which by the strangeness and darkness of this tabernacle of the body are sequestered) again revived and restored: such a light of nature I have observed in your majesty, and such a readiness to take flame, and blaze from the least occasion presented, or the least spark of another's knowledge delivered. And as the Scripture saith of the wisest king, *That his heart was as the sands of the sea*; which though it be one of the largest bodies, yet it consisteth of the smallest and finest portions: so hath God given your majesty a composition of understanding admirable, being able to compass and comprehend the greatest matters, and nevertheless to touch and apprehend the least; whereas it should seem an impossibility in nature, for the same instrument to make itself fit for great and small works. And for your gift of speech, I call to mind what Cornelius Tacitus saith of Augustus Cæsar; *Augusto profluens, et quæ principem deceret, eloquentia fuit:* For, if we note it well, speech that is uttered with labour and difficulty, or speech that savoureth of the affectation of art and precepts, or speech that is framed after the imitation of some pattern of eloquence, though never so excellent; all this has somewhat servile, and holding of the subject. But your majesty's manner of speech is indeed prince-like, flowing as from a fountain, and yet streaming and branching itself into nature's order, full of facility and felicity, imitating none, and inimitable by any. And as in your civil estate there appeareth to be an emulation and contention of your majesty's virtue with your fortune; a virtuous disposition with a fortunate regiment; a virtuous expectation, when time was, of your greater fortune, with a prosperous possession thereof in the due time; a virtuous observation of the

laws of marriage, with most blessed and happy fruit of marriage; a virtuous and most christian desire of peace, with a fortunate inclination in your neighbour princes thereunto: so likewise, in these intellectual matters, there seemeth to be no less contention between the excellency of your majesty's gifts of nature, and the universality and perfection of your learning. For I am well assured, that this which I shall say is no amplification at all, but a positive and measured truth; which is, that there hath not been since Christ's time any king or temporal monarch, which hath been so learned in all literature and erudition, divine and human. For let a man seriously and diligently revolve and peruse the succession of the emperors of Rome, of which Cæsar the dictator, who lived some years before Christ, and Marcus Antoninus, were the best learned; and so descend to the emperors of Græcia, or of the West; and then to the lines of France, Spain, England, Scotland, and the rest, and he shall find this judgment is truly made. For it seemeth much in a king, if, by the compendious extractions of other mens wits and labours, he can take hold of any superficial ornaments and shews of learning, or if he countenance and prefer learning and learned men: but to drink indeed of the true fountains of learning, nay, to have such a fountain of learning in himself, in a king, and in a king born, is almost a miracle. And the more because there is met in your majesty a rare conjunction, as well of divine and sacred literature, as of profane and human; so as your majesty standeth invested of that triplicity, which in great veneration was ascribed to the ancient Hermes: the power and fortune of a king, the knowledge and illumination of a priest, and the learning and universality of a philosopher. This propriety, inherent and individual attribute in your majesty, deserveth to be expressed, not only in the fame and admiration of the present time, nor in the history or tradition of the ages succeeding; but also in some solid work, fixed memorial, and immortal monument, bearing a character or signature, both of the power

of a king, and the difference and perfection of such a king.

Therefore I did conclude with myself, that I could not make unto your majesty a better oblation, than of some treatise tending to that end, whereof the sum will consist of these two parts; the former, concerning the excellency of learning and knowledge, and the excellency of the merit and true glory in the augmentation and propagation thereof: the latter, what the particular acts and works are, which have been embraced and undertaken for the advancement of learning; and again, what defects and undervalues I find in such particular acts: to the end, that though I cannot positively or affirmatively advise your majesty, or propound unto you framed particulars; yet I may excite your princely cogitations to visit the excellent treasure of your own mind, and thence to extract particulars for this purpose, agreeable to your magnanimity and wisdom.

IN the entrance to the former of these, to clear the way, and, as it were, to make silence, to have the true testimonies concerning the dignity of learning to be better heard, without the interruption of tacit objections; I think good to deliver it from the discredits and disgraces which it hath received, all from ignorance, but ignorance severally disguised; appearing sometimes in the zeal and jealousy of divines, sometimes in the severity and arrogancy of politicians, and sometimes in the errors and imperfections of learned men themselves.

I hear the former sort say, that knowledge is of those things which are to be accepted of with great limitation and caution; that the aspiring to overmuch knowledge, was the original temptation and sin, whereupon ensued the fall of man; that knowledge hath in it somewhat of the serpent, and therefore where it entereth into a man it makes him swell; *Scientia inflat:* that Solomon gives a censure, *That there is no end of making books, and that much reading is a weariness of the flesh;* and again in another

place, *That in spacious knowledge there is much contristation, and that he that increaseth knowledge increaseth anxiety;* that St. Paul gives a caveat, *That we be not spoiled through vain philosophy;* that experience demonstrates how learned men have been archheretics, how learned times have been inclined to atheism, and how the contemplation of second causes, doth derogate from our dependance upon God who is the first cause.

To discover then the ignorance and error of this opinion, and the misunderstanding in the grounds thereof, it may well appear these men do not observe or consider, that it was not the pure knowledge of nature and universality, a knowledge by the light whereof man did give names unto other creatures in paradise, as they were brought before him, according unto their proprieties, which gave occasion to the fall; but it was the proud knowledge of good and evil, with an intent in man to give law unto himself, and to depend no more upon God's commandments, which was the form of the temptation. Neither is it any quantity of knowledge, how great soever, that can make the mind of man to swell; for nothing can fill, much less extend the soul of man, but God, and the contemplation of God; and therefore Solomon, speaking of the two principal senses of inquisition, the eye and the ear, affirmeth that the eye is never satisfied with seeing, nor the ear with hearing; and if there be no fulness, then is the continent greater than the content: so of knowledge itself, and the mind of man, whereto the senses are but reporters, he defineth likewise in these words, placed after that calendar or ephemerides, which he maketh of the diversities of times and seasons for all actions and purposes; and concludeth thus: *God hath made all things beautiful, or decent, in the true return of their seasons: Also he hath placed the world in man's heart, yet cannot man find out the work which God worketh from the beginning to the end:* declaring, not obscurely, that God hath framed the mind of man as a mirror, or glass, capable of the image of the universal

world, and joyful to receive the impression thereof, as the eye joyeth to receive light; and not only delighted in beholding the variety of things, and vicissitude of times, but raised also to find out and discern the ordinances and decrees, which throughout all those changes are infallibly observed. And although he doth insinuate, that the supreme or summary law of nature, which he calleth, *The work which God worketh from the beginning to the end, is not possible to be found out by man*; yet that doth not derogate from the capacity of the mind, but may be referred to the impediments, as of shortness of life, ill conjunction of labours, ill tradition of knowledge over from hand to hand, and many other inconveniencies, whereunto the condition of man is subject. For that nothing parcel of the world is denied to man's inquiry and invention, he doth in another place rule over, when he saith, *The spirit of man is as the lamp of God, wherewith he searcheth the inwardness of all secrets.* If then such be the capacity and receipt of the mind of man, it is manifest, that there is no danger at all in the proportion or quantity of knowledge, how large soever, lest it should make it swell or out compass itself; no, but it is merely the quality of knowledge, which be it in quantity more or less, if it be taken without the true corrective thereof, hath in it some nature of venom or malignity, and some effects of that venom, which is ventosity or swelling. This corrective spice, the mixture whereof maketh knowledge so sovereign, is charity, which the apostle immediately addeth to the former clause; for so he saith, *knowledge bloweth up, but charity buildeth up*; not unlike unto that which he delivereth in another place: *If I spake*, saith he, *with the tongues of men and angels, and had not charity, it were but as a tinkling cymbal*; not but that it is an excellent thing to speak with the tongues of men and angels, but because, if it be severed from charity, and not referred to the good of men and mankind, it hath rather a sounding and unworthy glory, than a meriting and substantial virtue. And as for that censure of Solo-

mon, concerning the excess of writing and reading books, and the anxiety of spirit which redoundeth from knowledge; and that admonition of St. Paul, *That we be not seduced by vain philosophy;* let those places be rightly understood, and they do indeed excellently set forth the true bounds and limitations, whereby human knowledge is confined and circumscribed; and yet without any such contracting or coarctation, but that it may comprehend all the universal nature of things; for these limitations are three: the first, that we do not so place our felicity in knowledge, as to forget our mortality. The second, that we make application of our knowledge, to give ourselves repose and contentment, and not distaste or repining. The third, that we do not presume by the contemplation of nature to attain to the mysteries of God. For as touching the first of these, Solomon doth excellently expound himself in another place of the same book, where he saith; *I saw well that knowledge recedeth as far from ignorance, as light doth from darkness; and that the wise man's eyes keep watch in his head, whereas the fool roundeth about in darkness: but withal I learned, that the same mortality involveth them both.* And for the second, certain it is, there is no vexation or anxiety of mind which resulteth from knowledge, otherwise than merely by accident; for all knowledge, and wonder (which is the seed of knowledge) is an impression of pleasure in itself: but when men fall to framing conclusions out of their knowledge, applying it to their particular, and ministring to themselves thereby weak fears, or vast desires, there groweth that carefulness and trouble of mind which is spoken of: for then knowledge is no more *Lumen siccum*, whereof Heraclitus, the profound, said, *Lumen siccum optima anima;* but it becometh *Lumen madidum*, or *maceratum*, being steeped and infused in the humours of the affections. And as for the third point, it deserveth to be a little stood upon, and not to be lightly passed over: for if any man shall think by view and inquiry into these sensible and material things to attain that light, where-

by he may reveal unto himself the nature or will of God, then indeed is he spoiled by vain philosophy: for the contemplation of God's creatures and works produceth (having regard to the works and creatures themselves) knowledge; but having regard to God, no perfect knowledge, but wonder, which is broken knowledge. And therefore it was most aptly said by one of Plato's school, "That the sense of man "carrieth a resemblance with the sun, which, as we "see, openeth and revealeth all the terrestrial globe; "but then again it obscureth and concealeth the "stars and celestial globe: so doth the sense dis-"cover natural things, but it darkeneth and shutteth "up divine." And hence it is true, that it hath proceeded, that divers great learned men have been heretical, whilst they have sought to fly up to the secrets of the Deity by the waxen wings of the senses; and as for the conceit that too much knowledge should incline a man to atheism, and that the ignorance of second causes, should make a more devout dependence upon God who is the first cause: First, it is good to ask the question which Job asked of his friends: *Will you lie for God, as one man will do for another, to gratify him?* For certain it is, that God worketh nothing in nature but by second causes; and if they would have it otherwise believed, it is mere imposture, as it were in favour towards God; and nothing else but to offer to the author of truth the unclean sacrifice of a lie. But farther, it is an assured truth, and a conclusion of experience, that a little or superficial knowledge of philosophy may incline the mind of man to atheism, but a farther proceeding therein doth bring the mind back again to religion; for in the entrance of philosophy, when the second causes, which are next unto the senses, do offer themselves to the mind of man, if it dwell and stay there, it may induce some oblivion of the highest cause; but when a man passeth on farther, and seeth the dependence of causes, and the works of providence; then, according to the allegory of the poets, he will easily believe that the highest link of

nature's chain must needs be tied to the foot of Jupiter's chair. To conclude therefore: let no man, upon a weak conceit of sobriety, or an ill-applied moderation, think or maintain, that a man can search too far, or be too well studied in the book of God's word, or in the book of God's works; divinity or philosophy; but rather let men endeavour an endless progress, or proficience in both; only let men beware that they apply both to charity, and not to swelling; to use, and not to ostentation; and again, that they do not unwisely mingle, or confound these learnings together.

And as for the disgraces which learning receiveth from politicians, they be of this nature; that learning doth soften mens minds, and makes them more unapt for the honour and exercise of arms; that it doth mar and pervert mens dispositions for matter of government and policy, in making them too curious and irresolute by variety of reading, or too peremptory or positive by strictness of rules and axioms, or too immoderate and overweening by reason of the greatness of examples, or too incompatible and differing from the times, by reason of the dissimilitude of examples; or at least, that it doth divert mens travels from action and business, and bringeth them to a love of leisure and privateness; and that it doth bring into states a relaxation of discipline, whilst every man is more ready to argue, than to obey and execute. Out of this conceit, Cato, surnamed the Censor, one of the wisest men indeed that ever lived, when Carneades the philosopher came in embassage to Rome, and that the young men of Rome began to flock about him, being allured with the sweetness and majesty of his eloquence and learning, gave counsel in open senate, that they should give him his dispatch with all speed, lest he should infect and inchant the minds and affections of the youth, and at unawares bring in an alteration of the manners and customs of the state. Out of the same conceit, or humour, did Virgil, turning his pen to the advantage of his country, and the disadvantage of his own profession, make a kind of

separation between policy and government, and between arts and sciences, in the verses so much renowned, attributing and challenging the one to the Romans, and leaving and yielding the other to the Grecians; *Tu regere imperio populos, Romane, memento, Hæ tibi erunt artes, etc.* So likewise we see that Anytus, the accuser of Socrates, laid it as an article of charge and accusation against him, that he did, with the variety and power of his discourses and disputations, withdraw young men from due reverence to the laws and customs of their country; and that he did profess a dangerous and pernicious science, which was, to make the worst matter seem the better, and to suppress truth by force of eloquence and speech.

But these, and the like imputations, have rather a countenance of gravity, than any ground of justice: for experience doth warrant, that both in persons and in times, there hath been a meeting and concurrence in learning and arms, flourishing and excelling in the same men, and the same ages. For, as for men, there cannot be a better, nor the like instance, as of that pair, Alexander the Great and Julius Cæsar the dictator; whereof the one was Aristotle's scholar in philosophy, and the other was Cicero's rival in eloquence: or if any man had rather call for scholars that were great generals, than generals that were great scholars, let him take Epaminondas the Theban, or Xenophon the Athenian; whereof the one was the first that abated the power of Sparta, and the other was the first that made way to the overthrow of the monarchy of Persia. And this concurrence is yet more visible in times than in persons, by how much an age is a greater object than a man. For both in Ægypt, Assyria, Persia, Græcia, and Rome, the same times that are most renowned for arms, are likewise most admired for learning; so that the greatest authors and philosophers, and the greatest captains and governors, have lived in the same ages. Neither can it otherwise be: for as, in man, the ripeness of strength of the body and mind cometh much about an age,

save that the strength of the body cometh somewhat the more early; so in states, arms and learning, whereof the one correspondeth to the body the other to the soul of man, have a concurrence or near sequence in times.

And for matter of policy and government, that learning should rather hurt, than enable thereunto, is a thing very improbable: we see it is accounted an error to commit a natural body to empiric physicians, which commonly have a few pleasing receipts, whereupon they are confident and adventurous, but know neither the causes of diseases, nor the complexions of patients, nor peril of accidents, nor the true method of cures: we see it is a like error to rely upon advocates or lawyers which are only men of practice, and not grounded in their books, who are many times easily surprised, when matter falleth out besides their experience, to the prejudice of the causes they handle: so, by like reason, it cannot be but a matter of doubtful consequence, if states be managed by empiric statesmen, not well mingled with men grounded in learning. But contrariwise, it is almost without instance contradictory, that ever any government was disastrous that was in the hands of learned governors. For howsoever it hath been ordinary with politic men to extenuate and disable learned men by the names of pedants; yet in the records of time it appeareth, in many particulars, that the governments of princes in minority (notwithstanding the infinite disadvantage of that kind of state) have nevertheless excelled the government of princes of mature age, even for that reason which they seek to traduce, which is, that by that occasion the state hath been in the hands of pedants: for so was the state of Rome for the first five years, which are so much magnified, during the minority of Nero, in the hands of Seneca, a pedant: so it was again, for ten years space or more, during the minority of Gordianus the younger, with great applause and contentation in the hands of Misitheus, a pedant: so was it before that, in the minority of Alexander Severus, in like happiness, in

hands not much unlike, by reason of the rule of the women, who were aided by the teachers and preceptors. Nay, let a man look into the government of the bishops of Rome, as by name, into the government of Pius Quintus, and Sextus Quintus, in our times, who were both at their entrance esteemed but as pedantical friers, and he shall find that such popes do greater things, and proceed upon truer principles of state, than those which have ascended to the papacy from an education and breeding in affairs of state and courts of princes; for although men bred in learning are perhaps to seek in points of convenience, and accommodating for the present, which the Italians call *ragioni di stato*, whereof the same Pius Quintus could not hear spoken with patience, terming them inventions against religion and the moral virtues; yet on the other side, to recompense that, they are perfect in those same plain grounds of religion, justice, honour, and moral virtue, which if they be well and watchfully pursued, there will be seldom use of those other, no more than of physic in a sound or well-dieted body. Neither can the experience of one man's life furnish examples and precedents for the events of one man's life: for as it happeneth sometimes that the grandchild, or other descendent, resembleth the ancestor more than the son; so many times occurrences of present times may sort better with ancient examples, than with those of the later or immediate times: and lastly, the wit of one man can no more countervail learning, than one man's means can hold way with a common purse.

And as for those particular seducements, or indispositions of the mind for policy and government, which learning is pretended to insinuate; if it be granted that any such thing be, it must be remembered withal, that learning ministreth in every of them greater strength of medicine or remedy, than it offereth cause of indisposition or infirmity; for if, by a secret operation, it makes men perplexed and irresolute, on the other side, by plain precept, it teacheth them when and upon what ground to resolve; yea, and how to carry

things in suspense without prejudice, till they resolve; if it make men positive and regular, it teacheth them what things are in their nature demonstrative, and what are conjectural; and as well the use of distinctions and exceptions, as the latitude of principles and rules. If it mislead by disproportion, or dissimilitude of examples, it teacheth men the force of circumstances, the errors of comparisons, and all the cautions of application; so that in all these it doth rectify more effectually than it can pervert. And these medicines it conveyeth into mens minds much more forcibly by the quickness and penetration of examples. For let a man look into the errors of Clement the seventh, so lively described by Guicciardine, who served under him, or into the errors of Cicero, painted out by his own pencil in his epistles to Atticus, and he will fly apace from being irresolute. Let him look into the errors of Phocion, and he will beware how he be obstinate or inflexible. Let him but read the fable of Ixion, and it will hold him from being vaporous or imaginative. Let him look into the errors of Cato the second, and he will never be one of the Antipodes, to tread opposite to the present world.

And for the conceit, that learning should dispose men to leisure and privateness, and make men slothful; it were a strange thing if that, which accustometh the mind to a perpetual motion and agitation, should induce slothfulness; whereas contrariwise it may be truly affirmed, that no kind of men love business for itself, but those that are learned; for other persons love it for profit, as an hireling, that loves the work for the wages; or for honour, as because it beareth them up in the eyes of men, and refresheth their reputation, which otherwise would wear; or because it putteth them in mind of their fortune, and giveth them occasion to pleasure and displeasure; or because it exerciseth some faculty wherein they take pride, and so entertaineth them in good humour and pleasing conceits toward themselves; or because it advanceth any other their ends. So that, as it is said of untrue valours, that some mens valours are in the

eyes of them that look on; so such mens industries are in the eyes of others, or at least in regard of their own designments: only learned men love business, as an action according to nature, as agreeable to health of mind, as exercise is to health of body, taking pleasure in the action itself, and not in the purchase: so that of all men they are the most indefatigable, if it be towards any business which can hold or detain their mind.

And if any man be laborious in reading and study, and yet idle in business and action, it groweth from some weakness of body, or softness of spirit; such as Seneca speaketh of: *Quidam tam sunt umbratiles, ut putent in turbido esse, quicquid in luce est;* and not of learning: well may it be, that such a point of a man's nature may make him give himself to learning, but it is not learning that breedeth any such point in his nature.

And that learning should take up too much time or leisure: I answer; the most active or busy man that hath been or can be, hath, no question, many vacant times of leisure, while he expecteth the tides and returns of business (except he be either tedious and of no dispatch, or lightly and unworthily ambitious to meddle in things that may be better done by others:) and then the question is but, how those spaces and times of leisure shall be filled and spent; whether in pleasures or in studies; as was well answered by Demosthenes to his adversary Æschines, that was a man given to pleasure, and told him, that his orations did smell of the lamp: "Indeed," said Demosthenes, "there is a great difference between the things that "you and I do by lamp-light." So as no man need doubt that learning will expulse business; but rather it will keep and defend the possession of the mind against idleness and pleasure, which otherwise at unawares may enter, to the prejudice of both.

Again, for that other conceit, that learning should undermine the reverence of laws and government, it is assuredly a mere depravation and calumny, without any shadow of truth. For to say, that a blind

custom of obedience should be a surer obligation, than duty taught and understood; it is to affirm, that a blind man may tread surer by a guide, than a seeing man can by a light. And it is without all controversy, that learning doth make the minds of men gentle, generous, amiable and pliant to government; whereas ignorance makes them churlish, thwarting, and mutinous: and the evidence of time doth clear this assertion, considering that the most barbarous, rude, and unlearned times have been most subject to tumults, seditions, and changes.

And as to the judgment of Cato the Censor, he was well punished for his blasphemy against learning, in the same kind wherein he offended; for when he was past threescore years old, he was taken with an extreme desire to go to school again, and to learn the Greek tongue, to the end to peruse the Greek authors; which doth well demonstrate, that his former censure of the Grecian learning was rather an affected gravity, than according to the inward sense of his own opinion. And as for Virgil's verses, though it pleased him to brave the world in taking to the Romans the art of empire, and leaving to others the arts of subjects; yet so much is manifest, that the Romans never ascended to that height of empire, till the time they had ascended to the height of other arts. For in the time of the two first Cæsars, which had the art of government in greatest perfection, there lived the best poet, Virgilius Maro; the best historiographer, Titus Livius; the best antiquary, Marcus Varro; and the best, or second orator, Marcus Cicero, that to the memory of man are known. As for the accusation of Socrates, the time must be remembered when it was prosecuted; which was under the thirty tyrants, the most base, bloody, and envious persons that have governed; which revolution of state was no sooner over, but Socrates, whom they had made a person criminal, was made a person heroical, and his memory accumulate with honours divine and human; and those discourses of his, which were then termed corrupting of manners, were after acknow-

ledged for sovereign medicines of the mind and manners, and so have been received ever since till this day. Let this therefore serve for answer to politicians, which, in their humorous severity, or in their feigned gravity, have presumed to throw imputations upon learning; which redargution, nevertheless, (save that we know not whether our labours may extend to other ages) were not needful for the present, in regard of the love and reverence towards learning, which the example and countenance of two so learned princes, queen Elizabeth, and your majesty, being as Castor and Pollux, *lucida sidera*, stars of excellent light and most benign influence, hath wrought in all men of place and authority in our nation.

Now therefore we come to that third sort of discredit, or diminution of credit, that groweth unto learning from learned men themselves, which commonly cleaveth fastest: it is either from their fortune, or from their manners, or from the nature of their studies. For the first, it is not in their power; and the second is accidental; the third only is proper to be handled: but because we are not in hand with true measure, but with popular estimation and conceit, it is not amiss to speak somewhat of the two former. The derogations therefore, which grow to learning from the fortune or condition of learned men, are either in respect of scarcity of means, or in respect of privateness of life, and meanness of employments.

Concerning want, and that it is the case of learned men usually to begin with little, and not to grow rich so fast as other men, by reason they convert not their labours chiefly to lucre and increase: It were good to leave the common place in commendation of poverty to some frier to handle, to whom much was attributed by Machiavel in this point; when he said, "That the kingdom of the clergy had been "long before at an end, if the reputation, and re-"verence towards the poverty of friers had not borne "out the scandal of the superfluities and excesses of

" bishops and prelates." So a man might say, that the felicity and delicacy of princes and great persons had long since turned to rudeness and barbarism, if the poverty of learning had not kept up civility and honour of life: but, without any such advantages, it is worthy the observation, what a reverend and honoured thing poverty of fortune was, for some ages, in the Roman state, which nevertheless was a state without paradoxes: for we see what Titus Livius saith in his introduction: *Cæterum aut me amor negotii suscepti fallit, aut nulla unquam respublica nec major, nec sanctior, nec bonis exemplis ditior fuit; nec in quam tam seræ avaritia luxuriaque immigraverint; nec ubi tantus ac tam diu paupertati ac parsimoniæ honos fuerit.* We see likewise, after that the state of Rome was not itself, but did degenerate, how that person, that took upon him to be counsellor to Julius Cæsar after his victory, where to begin his restoration of the state, maketh it of all points the most summary to take away the estimation of wealth: *Verum hæc, et omnia mala pariter cum honore pecuniæ desinent, si neque magistratus, neque alia vulgo cupienda, venalia erunt.* To conclude this point, as it was truly said, that *rubor est virtutis color*, though sometimes it comes from vice: so it may be fitly said that *paupertas est virtutis fortuna;* though sometimes it may proceed from misgovernment and accident. Surely Solomon hath pronounced it both in censure, *Qui festinat ad divitias, non erit insons;* and in precept; *Buy the truth, and sell it not;* and so of wisdom and knowledge; judging that means were to be spent upon learning, and not learning to be applied to means. And as for the privateness, or obscureness (as it may be in vulgar estimation accounted) of life of contemplative men; it is a theme so common, to extol a private life not taxed with sensuality and sloth, in comparison, and to the disadvantage of a civil life, for safety, liberty, pleasure, and dignity, or at least freedom from indignity, as no man handleth it, but handleth it well: such a consonancy it hath to mens conceits in the expressing, and to mens consents in the al-

lowing. This only I will add, that learned men forgotten in states, and not living in the eyes of men, are like the images of Cassius and Brutus in the funeral of Junia; of which not being represented, as many others were, Tacitus saith, *Eo ipso præfulgebant, quod non visebantur.*

And for meanness of employment, that which is most traduced to contempt, is, that the government of youth is commonly allotted to them; which age, because it is the age of least authority, it is transferred to the disesteeming of those employments wherein youth is conversant, and which are conversant about youth. But how unjust this traducement is (if you will reduce things from popularity of opinion to measure of reason) may appear in that, we see men are more curious what they put into a new vessel, than into a vessel seasoned; and what mould they lay about a young plant, than about a plant corroborate; so as the weakest terms and times of all things use to have the best applications and helps. And will you hearken to the Hebrew Rabbins? *Your young men shall see visions, and your old men shall dream dreams:* say they, youth is the worthier age, for that visions are nearer apparitions of God than dreams. And let it be noted, that howsoever the condition of life of pedants hath been scorned upon theatres, as the ape of tyranny; and that the modern looseness or negligence hath taken no due regard to the choice of schoolmasters and tutors; yet the ancient wisdom of the best times did always make a just complaint, that states were too busy with their laws, and too negligent in point of education: which excellent part of ancient discipline hath been in some sort revived of late times, by the colleges of the Jesuits; of whom, although in regard of their superstition I may say, *quo meliores, eo deteriores;* yet in regard of this, and some other points concerning human learning and moral matters, I may say, as Agesilaus said to his enemy Pharnabasus, *Talis quum sis, utinam noster esses.* And thus much touching the discredits drawn from the fortunes of learned men.

As touching the manners of learned men, it is a thing personal and individual: and no doubt there be amongst them, as in other professions, of all temperatures: but yet so as it is not without truth, which is said, that *abeunt studia in mores*, studies have an influence and operation upon the manners of those that are conversant in them.

But upon an attentive and indifferent review, I, for my part, cannot find any disgrace to learning can proceed from the manners of learned men not inherent to them as they are learned; except it be a fault (which was the supposed fault of Demosthenes, Cicero, Cato the second, Seneca, and many more) that, because the times they read of are commonly better than the times they live in, and the duties taught better than the duties practised, they contend sometimes too far to bring things to perfection, and to reduce the corruption of manners to honesty of precepts, or examples of too great height. And yet hereof they have caveats enough in their own walks. For Solon, when he was asked whether he had given his citizens the best laws, answered wisely, "Yea, of such as they would receive:" and Plato, finding that his own heart could not agree with the corrupt manners of his country, refused to bear place or office; saying, "That a man's country was to be used as his "parents were, that is, with humble persuasions, and "not with contestations." And Cæsar's counsellor put in the same caveat, *Non ad vetera instituta revocans, quæ jampridem corruptis moribus ludibrio sunt:* and Cicero noteth this error directly in Cato the second, when he writes to his friend Atticus; *Cato optime sentit, sed nocet interdum reipublicæ; loquitur enim tanquam in respublica Platonis, non tanquam in fæce Romuli.* And the same Cicero doth excuse and expugn the philosophers for going too far, and being too exact in their prescripts, when he saith, *Isti ipsi præceptores virtutis, et magistri videnter fines officiorum paulo longius, quam natura vellet, protulisse, ut cum ad ultimum animo contendissemus, ibi tamen, ubi oportet, consisteremus:* and yet himself might have said,

Monitis sum minor ipse meis; for it was his own fault, though not in so extreme a degree.

Another fault likewise much of this kind hath been incident to learned men; which is, that they have esteemed the preservation, good and honour of their countries or masters, before their own fortunes or safeties. For so saith Demosthenes unto the Athenians: "If it please you to note it, my counsels "unto you are not such, whereby I should grow "great amongst you, and you become little amongst "the Grecians: but they be of that nature, as they "are sometimes not good for me to give, but are al-"ways good for you to follow." And so Seneca, after he had consecrated that *Quinquennium Neronis* to the eternal glory of learned governors, held on his honest and loyal course of good and free counsel, after his master grew extremely corrupt in his government. Neither can this point otherwise be; for learning endueth mens minds with a true sense of the frailty of their persons, the casualty of their fortunes, and the dignity of their soul and vocation: so that it is impossible for them to esteem that any greatness of their own fortune can be a true or worthy end of their being and ordainment; and therefore are desirous to give their account to God, and so likewise to their masters under God (as kings and the states that they serve) in these words; *Ecce tibi lucrefeci*, and not *Ecce mihi lucrefeci:* whereas the corrupter sort of mere politicians, that have not their thoughts established by learning in the love and apprehension of duty, nor ever look abroad into universality, do refer all things to themselves, and thrust themselves into the centre of the world, as if all lines should meet in them and their fortunes; never caring, in all tempests, what becomes of the ship of state, so they may save themselves in the cockboat of their own fortune; whereas men that feel the weight of duty, and know the limits of self-love, use to make good their places and duties, though with peril. And if they stand in seditious and violent alterations, it is rather the reverence which many times both adverse

parties do give to honesty, than any versatile advantage of their own carriage. But for this point of tender sense, and fast obligation of duty, which learning doth endue the mind withal, howsoever fortune may tax it, and many in the depth of their corrupt principles may despise it, yet it will receive an open allowance, and therefore needs the less disproof or excusation.

Another fault incident commonly to learned men, which may be more probably defended than truly denied, is, that they fail sometimes in applying themselves to particular persons: which want of exact application ariseth from two causes; the one, because the largeness of their mind can hardly confine itself to dwell in the exquisite observation or examination of the nature and customs of one person: for it is a speech for a lover, and not for a wise man: *Satis magnum alter alteri theatrum sumus.* Nevertheless I shall yield, that he that cannot contract the sight of his mind, as well as disperse and dilate it, wanteth a great faculty. But there is a second cause, which is no inability, but a rejection upon choice and judgment: for the honest and just bounds of observation, by one person upon another, extend no farther, but to understand him sufficiently, whereby not to give him offence, or whereby to be able to give him faithful counsel, or whereby to stand upon reasonable guard and caution, in respect of a man's self: but to be speculative into another man, to the end to know how to work him, or wind him, or govern him, proceedeth from a heart that is double and cloven, and not entire and ingenuous; which as in friendship it is want of integrity, so towards princes or superiors is want of duty. For the custom of the Levant, which is, that subjects do forbear to gaze or fix their eyes upon princes, is in the outward ceremony barbarous, but the moral is good: for men ought not, by cunning and bent observations, to pierce and penetrate into the hearts of kings, which the scripture hath declared to be inscrutable.

There is yet another fault (with which I will con-

clude this part) which is often noted in learned men, that they do many times fail to observe decency and discretion in their behaviour and carriage, and commit errors in small and ordinary points of action, so as the vulgar sort of capacities do make a judgment of them in greater matters, by that which they find wanting in them in smaller. But this consequence doth often deceive men, for which I do refer them over to that which was said by Themistocles, arrogantly and uncivilly being applied to himself out of his own mouth; but, being applied to the general state of this question, pertinently and justly; when, being invited to touch a lute, he said, "he could "not fiddle, but he could make a small town a great "state." So, no doubt, many may be well seen in the passages of government and policy, which are to seek in little and punctual occasions. I refer them also to that which Plato said of his master Socrates, whom he compared to the gallypots of apothecaries, which on the outside had apes and owls, and antiques, but contained within sovereign and precious liquors and confections; acknowledging, that to an external report he was not without superficial levities and deformities, but was inwardly replenished with excellent virtues and powers. And so much touching the point of manners of learned men.

But in the mean time I have no purpose to give allowance to some conditions and courses base and unworthy, wherein divers professors of learning have wronged themselves, and gone too far; such as were those trencher philosophers, which in the later age of the Roman state were usually in the houses of great persons, being little better than solemn parasites; of which kind, Lucian maketh a merry description of the philosopher that the great lady took to ride with her in her coach, and would needs have him carry her little dog, which he doing officiously, and yet uncomely, the page scoffed, and said, "That "he doubted, the philosopher of a Stoic would turn "to be Cynic." But above all the rest, the gross and palpable flattery, whereunto many, not un-

learned, have abased and abused their wits and pens, turning, as Du Bartas saith, Hecuba into Helena, and Faustina into Lucretia, hath most diminished the price and estimation of learning. Neither is the modern dedication of books and writings, as to patrons, to be commended: for that books, such as are worthy the name of books, ought to have no patrons but truth and reason. And the ancient custom was, to dedicate them only to private and equal friends, or to intitle the books with their names; or if to kings and great persons, it was to some such as the argument of the book was fit and proper for: but these and the like courses may deserve rather reprehension than defence.

Not that I can tax or condemn the morigeration or application of learned men to men in fortune. For the answer was good that Diogenes made to one that asked him in mockery, "How it came to pass that "philosophers were the followers of rich men, and "not rich men of philosophers?" He answered soberly, and yet sharply, "Because the one sort knew what they had need of, and the other did not." And of the like nature was the answer which Aristippus made, when having a petition to Dionysius, and no ear given to him, he fell down at his feet; whereupon Dionysius staid, and gave him the hearing, and granted it; and afterward some person, tender on the behalf of philosophy, reproved Aristippus, that he would offer the profession of philosophy such an indignity, as for a private suit to fall at a tyrant's feet. But he answered, "It was not his "fault, but it was the fault of Dionysius that he had "his ears in his feet." Neither was it accounted weakness, but discretion in him that would not dispute his best with Adrianus Cæsar; excusing himself, "That it was reason to yield to him that "commanded thirty legions." These and the like applications, and stooping to points of necessity and convenience, cannot be disallowed: for though they may have some outward baseness, yet in a judgment truly made, they are to be accounted submissions to the occasion, and not to the person.

Now I proceed to those errors and vanities, which have intervened amongst the studies themselves of the learned, which is that which is principal and proper to the present argument; wherein my purpose is not to make a justification of the errors, but, by a censure and separation of the errors, to make a justification of that which is good and sound, and to deliver that from the aspersion of the other. For we see, that it is the manner of men to scandalize and deprave that which retaineth the state and virtue, by taking advantage upon that which is corrupt and degenerate: as the heathens in the primitive church used to blemish and taint the Christians with the faults and corruptions of hereticks. But nevertheless I have no meaning at this time to make any exact animadversion of the errors and impediments in matters of learning, which are more secret and remote from vulgar opinion, but only to speak unto such as do fall under, or near unto, a popular observation.

There be therefore chiefly three vanities in studies, whereby learning hath been most traduced. For those things we do esteem vain, which are either false or frivolous, those which either have no truth, or no use: and those persons we esteem vain, which are either credulous or curious; and curiosity is either in matter, or words: so that in reason, as well as in experience, there fall out to be these three distempers, as I may term them, of learning: the first, fantastical learning; the second, contentious learning; and the last, delicate learning; vain imaginations, vain altercations, and vain affectations; and with the last I will begin.

Martin Luther, conducted no doubt by an higher providence, but in discourse of reason, finding what a province he had undertaken against the bishop of Rome, and the degenerate traditions of the church, and finding his own solitude, being no ways aided by the opinions of his own time, was enforced to awake all antiquity, and to call former times to his succour, to make a party against the present time, So that the ancient authors, both in divinity, and in

humanity, which had long time slept in libraries, began generally to be read and revolved. This by consequence did draw on a necessity of a more exquisite travel in the languages original, wherein those authors did write, for the better understanding of those authors, and the better advantage of pressing and applying their words. And thereof grew again a delight in their manner of style and phrase, and an admiration of that kind of writing; which was much furthered and precipitated by the enmity and opposition, that the propounders of those primitive, but seeming new, opinions had against the schoolmen, who were generally of the contrary part, and whose writings were altogether in a differing stile and form, taking liberty to coin, and frame new terms of art to express their own sense, and to avoid circuit of speech, without regard to the pureness, pleasantness, and, as I may call it, lawfulness, of the phrase or word. And again, because the great labour then was with the people, of whom the Pharisees were wont to say, *Execrabilis ista turba, quæ non novit legem;* for the winning and persuading of them, there grew of necessity in chief price and request, eloquence and variety of discourse, as the fittest and forciblest access into the capacity of the vulgar sort: so that these four causes concurring, the admiration of ancient authors, the hate of the schoolmen, the exact study of languages, and the efficacy of preaching, did bring in an affected study of eloquence, and *copia* of speech, which then began to flourish. This grew speedily to an excess; for men began to hunt more after words than matter; and more after the choiceness of the phrase, and the round and clean composition of the sentence, and the sweet falling of the clauses, and the varying and illustration of their works with tropes and figures, than after the weight of matter, worth of subject, soundness of argument, life of invention, or depth of judgment. Then grew the flowing and watry vein of Osorius, the Portugal bishop, to be in price. Then did Sturmius spend such infinite and curious pains upon

Cicero the orator, and Hermogenes the rhetorician, besides his own books of periods, and imitation, and the like. Then did Car of Cambridge, and Ascham, with their lectures and writings, almost deify Cicero and Demosthenes, and allure all young men, that were studious, unto that delicate and polished kind of learning. Then did Erasmus take occasion to make the scoffing echo; *Decem annos consumpsi in legendo Cicerone:* and the echo answered in Greek, Ὄνε, *Asine.* Then grew the learning of the schoolmen to be utterly despised as barbarous. In sum, the whole inclination and bent of those times was rather towards *copia*, than weight.

Here therefore is the first distemper of learning, when men study words, and not matter: whereof though I have represented an example of late times, yet it hath been, and will be *secundum majus et minus* in all time. And how is it possible but this should have an operation to discredit learning, even with vulgar capacities, when they see learned mens works like the first letter of a patent, or limned book; which though it hath large flourishes, yet it is but a letter? It seems to me that Pygmalion's frenzy is a good emblem or portraiture of this vanity: for words are but the images of matter, and except they have life of reason and invention, to fall in love with them is all one, as to fall in love with a picture.

But yet, notwithstanding, it is a thing not hastily to be condemned, to clothe and adorn the obscurity, even of philosophy itself, with sensible and plausible elocution; for hereof we have great examples in Xenophon, Cicero, Seneca, Plutarch, and of Plato also in some degree; and hereof likewise there is great use: for surely, to the severe inquisition of truth, and the deep progress into philosophy, it is some hindrance; because it is too early satisfactory to the mind of man, and quencheth the desire of farther search, before we come to a just period; but then, if a man be to have any use of such knowledge in civil occasions, of conference, counsel, persuasion, discourse, or the like; then shall he find it

prepared to his hands in those authors which write in that manner. But the excess of this is so justly contemptible, that as Hercules, when he saw the image of Adonis, Venus's minion, in a temple, said in disdain, *Nil sacri es;* so there is none of Hercules's followers in learning, that is, the more severe and laborious sort of inquirers into truth, but will despise those delicacies and affectations, as indeed capable of no divineness. And thus much of the first disease or distemper of learning.

The second, which followeth, is in nature worse than the former: for as substance of matter is better than beauty of words, so, contrariwise, vain matter is worse than vain words; wherein it seemeth the reprehension of St. Paul was not only proper for those times, but prophetical for the times following; and not only respective to divinity, but extensive to all knowledge: *Devita profanas vocum novitates, et oppositiones falsi nominis scientiæ.* For he assigneth two marks and badges of suspected and falsified science: the one, the novelty and strangeness of terms; the other, the strictness of positions, which of necessity doth induce oppositions, and so questions and altercations. Surely, like as many substances in nature which are solid, do putrify and corrupt into worms; so it is the property of good and sound knowledge, to putrify and dissolve into a number of subtle, idle, unwholsome, and, as I may term them, vermiculate questions, which have indeed a kind of quickness, and life of spirit, but no soundness of matter, or goodness of quality. This kind of degenerate learning did chiefly reign amongst the schoolmen, who, having sharp and strong wits, and abundance of leisure, and small variety of reading; but their wits being shut up in the cells of a few authors, chiefly Aristotle their dictator, as their persons were shut up in the cells of monasteries and colleges, and knowing little history, either of nature or time, did, out of no great quantity of matter, and infinite agitation of wit, spin out unto us those laborious webs of learning, which are extant in their books. For the

wit and mind of man, if it work upon matter, which is the contemplation of the creatures of God, worketh according to the stuff, and is limited thereby: but if it work upon itself, as the spider worketh his web, then it is endless, and brings forth indeed cobwebs of learning, admirable for the fineness of thread and work, but of no substance or profit.

The same unprofitable subtilty or curiosity is of two sorts; either in the subject itself that they handle, when it is a fruitless speculation, or controversy, whereof there are no small number both in divinity and philosophy, or in the manner or method of handling of a knowledge, which amongst them was this; upon every particular position or assertion to frame objections, and to those objections, solutions; which solutions were for the most part not confutations, but distinctions: whereas indeed the strength of all sciences is, as the strength of the old man's faggot, in the band. For the harmony of a science, supporting each part the other, is and ought to be the true and brief confutation and suppression of all the smaller sort of objections. But, on the other side, if you take out every axiom, as the sticks of the faggot, one by one, you may quarrel with them, and bend them, and break them at your pleasure: so that as was said of Seneca, *Verborum minutiis rerum frangit pondera:* so a man may truly say of the schoolmen, *Quæstionum minutiis scientiarum frangunt soliditatem.* For were it not better for a man in a fair room, to set up one great light, or branching candlestick of lights, than to go about with a small watch candle into every corner? And such is their method, that rests not so much upon evidence of truth proved by arguments, authorities, similitudes, examples, as upon particular confutations and solutions of every scruple, cavillation, and objection; breeding for the most part one question, as fast as it solveth another; even as in the former resemblance, when you carry the light into one corner, you darken the rest: so that the fable and fiction of *Scylla* seemeth to be a lively image of this kind of philosophy or knowledge,

who was transformed into a comely virgin for the upper parts; but then, *Candida succinctam, latrantibus inguina monstris:* so the generalities of the schoolmen are for a while good and proportionable; but then, when you descend into their distinctions and decisions, instead of a fruitful womb, for the use and benefit of man's life, they end in monstrous altercations, and barking questions. So as it is not possible but this quality of knowledge must fall under popular contempt, the people being apt to contemn truth upon occasion of controversies and altercations, and to think they are all out of their way which never meet: and when they see such digladiation about subtilties, and matters of no use or moment, they easily fall upon that judgment of Dionysius of Syracuse, *Verba ista sunt senum otiosorum.*

Notwithstanding, certain it is that if those schoolmen, to their great thirst of truth, and unwearied travel of wit, had joined variety and universality of reading and contemplation, they had proved excellent lights, to the great advancement of all learning and knowledge; but as they are, they are great undertakers indeed, and fierce with dark keeping: but as in the inquiry of the divine truth, their pride inclined to leave the oracle of God's word, and to vanish in the mixture of their own inventions; so in the inquisition of nature, they ever left the oracle of God's works, and adored the deceiving and deformed images, which the unequal mirror of their own minds, or a few received authors or principles, did represent unto them. And thus much for the second disease of learning.

For the third vice or disease of learning, which concerneth deceit or untruth, it is of all the rest the foulest; as that which doth destroy the essential form of knowledge; which is nothing but a representation of truth; for the truth of being, and the truth of knowing are one, differing no more than the direct beam, and the beam reflected. This vice therefore brancheth itself into two sorts; delight in deceiving, and aptness to be deceived; imposture and

credulity; which, although they appear to be of a diverse nature, the one seeming to proceed of cunning, and the other of simplicity; yet certainly they do for the most part concur: for as the verse noteth,

Percontatorem fugito, nam garrulus idem est:

an inquisitive man is a prattler: so upon the like reason, a credulous man is a deceiver: as we see it in fame, that he that will easily believe rumours, will as easily augment rumours, and add somewhat to them of his own; which Tacitus wisely noteth, when he saith, *Fingunt simul creduntque:* so great an affinity hath fiction and belief.

This facility of credit, and accepting or admitting things weakly authorized or warranted, is of two kinds, according to the subject: for it is either a belief of history, as the lawyers speak, matter of fact; or else of matter of art and opinion: as to the former, we see the experience and inconvenience of this error in ecclesiastical history, which hath too easily received and registered reports and narrations of miracles wrought by martyrs, hermits, or monks of the desart, and other holy men, and their relicks, shrines, chapels, and images: which though they had a passage for time, by the ignorance of the people, the superstitious simplicity of some, and the politic toleration of others, holding them but as divine poesies: yet after a period of time, when the mist began to clear up, they grew to be esteemed but as old wives fables, impostures of the clergy, illusions of spirits, and badges of antichrist, to the great scandal and detriment of religion.

So in natural history, we see there hath not been that choice and judgment used as ought to have been, as may appear in the writings of Plinius, Cardanus, Albertus, and divers of the Arabians, being fraught with much fabulous matter, a great part not only untried, but notoriously untrue, to the great derogation of the credit of natural philosophy with the grave and sober kind of wits: wherein the wisdom and integrity of Aristotle is worthy to be observed, that, having made so diligent and exquisite

a history of living creatures, hath mingled it sparingly with any vain or feigned matter; and yet, on the other side, hath cast all prodigious narrations, which he thought worthy the recording, into one book: excellently discerning that matter of manifest truth, such, whereupon observation and rule was to be built, was not to be mingled or weakened with matter of doubtful credit; and yet again, that rarities and reports that seem incredible, are not to be suppressed or denied to the memory of men.

And as for the facility of credit which is yielded to arts and opinions, it is likewise of two kinds, either when too much belief is attributed to the arts themselves, or to certain authors in any art. The sciences themselves which have had better intelligence and confederacy with the imagination of man, than with his reason, are three in number: astrology, natural magic, and alchemy; of which sciences, nevertheless, the ends or pretences are noble. For astrology pretendeth to discover that correspondence, or concatenation, which is between the superior globe and the inferior. Natural magic pretendeth to call and reduce natural philosophy from variety of speculations to the magnitude of works; and alchemy pretendeth to make separation of all the unlike parts of bodies, which in mixtures of nature are incorporate. But the derivations and prosecutions to these ends, both in the the theories and in the practices, are full of error and vanity; which the great professors themselves have sought to veil over and conceal by enigmatical writings, and referring themselves to auricular traditions and such other devices, to save the credit of impostors: and yet surely to alchemy this right is due, that it may be compared to the husbandman whereof Æsop makes the fable; that, when he died, told his sons, that he had left unto them gold buried under ground in his vineyard; and they digged over all the ground, and gold they found none; but by reason of their stirring and digging the mould about the roots of their vines, they had a great vintage the year following: so assuredly

the search and stir to make gold hath brought to light a great number of good and fruitful inventions and experiments, as well for the disclosing of nature, as for the use of man's life.

And as to the overmuch credit that hath been given unto authors in sciences, in making them dictators, that their words should stand; and not consuls to give advice; the damage is infinite that sciences have received thereby, as the principal cause that hath kept them low, at a stay, without growth or advancement. For hence it hath come, that in arts mechanical, the first deviser comes shortest, and time addeth and perfecteth: but in sciences, the first author goeth farthest, and time loseth and corrupteth. So we see, artillery, sailing, printing, and the like, were grossly managed at the first, and by time accommodated and refined: but contrariwise the philosophies and sciences of Aristotle, Plato, Democritus, Hippocrates, Euclides, Archimedes, of most vigour at the first, are by time degenerate and imbased; whereof the reason is no other, but that in the former many wits and industries have contributed in one; and in the latter, many wits and industries have been spent about the wit of some one, whom many times they have rather depraved than illustrated. For as water will not ascend higher than the level of the first spring-head from whence it descendeth, so knowledge derived from Aristotle, and exempted from liberty of examination, will not rise again higher than the knowledge of Aristotle. And therefore although the position be good, *Oportet discentem credere;* yet it must be coupled with this, *Oportet edoctum judicare:* for disciples do owe unto masters only a temporary belief, and a suspension of their own judgment till they be fully instructed, and not an absolute resignation, or perpetual captivity: and therefore, to conclude this point, I will say no more; but so let great authors have their due, as time, which is the author of authors, be not deprived of his due, which is, farther and farther to discover truth. Thus I have gone over these three

diseases of learning; besides the which, there are some other rather peccant humours than formed diseases, which nevertheless are not so secret and intrinsic, but that they fall under a popular observation and traducement, and therefore are not to be passed over.

The first of these is the extreme affecting of two extremities: the one antiquity, the other novelty; wherein it seemeth the children of time do take after the nature and malice of the father. For as he devoureth his children, so one of them seeketh to devour and suppress the other, while antiquity envieth there should be new additions, and novelty cannot be content to add, but it must deface; surely, the advice of the prophet is the true direction in this matter, *State super vias antiquas, et videte quænam sit via recta, et bona, et ambulate in ea.* Antiquity deserveth that reverence, that men should make a stand thereupon, and discover what is the best way; but when the discovery is well taken, then to make progression. And to speak truly, *Antiquitas sæculi, juventus mundi.* These times are the ancient times, when the world is ancient, and not those which we account ancient *ordine retrogrado*, by a computation backward from ourselves.

Another error, induced by the former, is a distrust that any thing should be now to be found out, which the world should have missed and passed over so long time; as if the same objection were to be made to time, that Lucian maketh to Jupiter, and other the heathen gods, of which he wondereth that they begot so many children in old time, and begot none in his time; and asketh whether they were become septuagenery, or whether the law Papia, made against old mens marriages, had restrained them. So it seemeth men doubt, lest time is become past children and generation; wherein, contrariwise, we see commonly the levity and inconstancy of mens judgments, which till a matter be done, wonder that it can be done; and, as soon as it is done, wonder again that it was no sooner done; as we see in the

expedition of Alexander into Asia, which at first was prejudged as a vast and impossible enterprise: and yet afterwards it pleaseth Livy to make no more of it than this; *Nil aliud, quam bene ausus est vana contemnere:* and the same happened to Columbus in the western navigation. But in intellectual matters it is much more common; as may be seen in most of the propositions of Euclid, which till they be demonstrated, they seem strange to our assent; but being demonstrated, our mind accepteth of them by a kind of relation, as the lawyers speak, as if we had known them before.

Another error that hath also some affinity with the former, is a conceit, that of former opinions or sects, after variety and examination, the best hath still prevailed, and suppressed the rest: so as, if a man should begin the labour of a new search, he were but like to light upon somewhat formerly rejected, and by rejection brought into oblivion; as if the multitude, or the wisest, for the multitude's sake, were not ready to give passage, rather to that which is popular and superficial, than to that which is substantial and profound: for the truth is, that time seemeth to be of the nature of a river or stream, which carrieth down to us that which is light and blown up, and sinketh and drowneth that which is weighty and solid.

Another error, of a diverse nature from all the former, is the over early and peremptory reduction of knowledge into arts and methods; from which time commonly sciences receive small or no augmentation. But as young men, when they knit and shape perfectly, do seldom grow to a farther stature: so knowledge, while it is in aphorisms and observations, it is in growth; but when it once is comprehended in exact methods, it may perchance be farther polished and illustrated, and accommodated for use and practice; but it increaseth no more in bulk and substance.

Another error which doth succeed that which we last-mentioned, is, that after the distribution of par-

ticular arts and sciences, men have abandoned universality, or *philosophia prima;* which cannot but cease, and stop all progression. For no perfect discovery can be made upon a flat or a level: neither is it possible to discover the more remote, and deeper parts of any science, if you stand but upon the level of the same science, and ascend not to a higher science.

Another error hath proceeded from too great a reverence, and a kind of adoration of the mind and understanding of man: by means whereof, men have withdrawn themselves too much from the contemplation of nature, and the observations of experience, and have tumbled up and down in their own reason and conceits. Upon these intellectualists, which are, notwithstanding, commonly taken for the most sublime and divine philophers, Heraclitus gave a just censure, saying, "Men sought truth in their own "little worlds, and not in the great and common "world;" for they disdain to spell, and so by degrees to read in the volume of God's works; and contrariwise, by continual meditation and agitation of wit, do urge and as it were invocate their own spirits to divine, and give oracles unto them, whereby they are deservedly deluded.

Another error that hath some connexion with this latter, is that men have used to infect their meditations, opinions, and doctrines, with some conceits which they have most admired, or some sciences which they have most applied; and given all things else a tincture according to them, utterly untrue and improper. So hath Plato intermingled his philosophy with theology, and Aristotle with logic; and the second school of Plato, Proclus, and the rest, with the mathematics. For these were the arts which had a kind of primogeniture with them severally. So have the alchemists made a philosophy out of a few experiments of the furnace; and Gilbertus, our countryman, hath made a philosophy out of the observations of a loadstone. So Cicero, when, reciting the several opinions of the nature of the soul,

he found a musician, that held the soul was but a harmony, saith pleasantly, *Hic ab arte sua non recessit, etc.* But of these conceits Aristotle speaketh seriously and wisely, when he saith, *Qui respiciunt ad pauca, de facili pronuntiant.*

Another error is an impatience of doubt, and haste to assertion without due and mature suspension of judgment. For the two ways of contemplation are not unlike the two ways of action, commonly spoken of by the ancients: the one plain and smooth in the beginning, and in the end impassable; the other rough and troublesome in the entrance, but after a while fair and even: so it is in contemplation; if a man will begin with certainties, he shall end in doubts; but if he will be content to begin with doubts, he shall end in certainties.

Another error is in the manner of the tradition and delivery of knowledge, which is for the most part magisterial and peremptory; and not ingenuous and faithful, in a sort, as may be soonest believed; and not easiliest examined. It is true, that in compendious treatises for practice, that form is not to be disallowed. But in the true handling of knowledge, men ought not to fall either, on the one side, into the vein of Velleius the Epicurean: *Nil tam metuens, quam ne dubitare aliqua de re videretur:* nor, on the other side, into Socrates his ironical doubting of all things; but to propound things sincerely, with more or less asseveration, as they stand in a man's own judgment proved more or less.

Other errors there are in the scope that men propound to themselves, whereunto they bend their endeavours: for whereas the more constant and devote kind of professors of any science ought to propound to themselves to make some additions to their science, they convert their labours to aspire to certain second prizes; as to be a profound interpreter, or commentator; to be a sharp champion or defender; to be a methodical compounder or abridger; and so the patrimony of knowledge cometh to be sometimes improved, but seldom augmented.

But the greatest error of all the rest, is the mistaking or misplacing of the last or farthest end of knowledge: for men have entered into a desire of learning and knowledge, sometimes upon a natural curiosity, and inquisitive appetite; sometimes to entertain their minds with variety and delight; sometimes for ornament and reputation; and sometimes to enable them to victory of wit and contradiction; and most times for lucre and profession; and seldom sincerely to give a true account of their gift of reason, to the benefit and use of men: as if there were sought in knowledge a couch, whereupon to rest a searching and restless spirit; or a terras, for a wandering and variable mind to walk up and down with a fair prospect; or a tower of state, for a proud mind to raise itself upon; or a fort or commanding ground for strife and contention; or a shop, for profit, or sale; and not a rich storehouse, for the glory of the Creator, and the relief of man's estate. But this is that which will indeed dignify and exalt knowledge, if contemplation and action may be more nearly and straitly conjoined and united together than they have been; a conjunction like unto that of the two highest planets, Saturn, the planet of rest and contemplation, and Jupiter, the planet of civil society and action: howbeit, I do not mean, when I speak of use and action, that end before-mentioned of the applying of knowledge to lucre and profession; for I am not ignorant how much that diverteth and interrupteth the prosecution and advancement of knowledge, like unto the golden ball thrown before Atalanta, which while she goeth aside and stoopeth to take up, the race is hindered;

Declinant cursus, aurumque volubile tollit.

Neither is my meaning, as was spoken of Socrates, to call philosophy down from heaven to converse upon the earth; that is, to leave natural philosophy aside, and to apply knowledge only to manners and policy. But as both heaven and earth do conspire and contribute to the use and benefit of man; so the end ought to be, from both philosophies to separate

and reject vain speculations, and whatsoever is empty and void, and to preserve and augment whatsoever is solid and fruitful: that knowledge may not be, as a courtesan, for pleasure and vanity only, or as a bondwoman, to acquire and gain to her master's use; but as a spouse, for generation, fruit, and comfort.

Thus have I described and opened, as by a kind of dissection, those peccant humours, the principal of them, which have not only given impediment to the proficience of learning, but have given also occasion to the traducement thereof: wherein if I have been too plain, it must be remembered, *Fidelia vulnera amantis, sed dolosa oscula malignantis.*

This, I think, I have gained, that I ought to be the better believed in that which I shall say pertaining to commendation; because I have proceeded so freely in that which concerneth censure. And yet I have no purpose to enter into a laudative of learning, or to make a hymn to the muses, though I am of opinion that it is long since their rites were duly celebrated: but my intent is, without varnish or amplification, justly to weigh the dignity of knowledge in the balance with other things, and to take the true value thereof by testimonies and arguments divine and human.

First therefore, let us seek the dignity of knowledge in the archetype or first platform, which is in the attributes and acts of God, as far as they are revealed to man, and may be observed with sobriety; wherein we may not seek it by the name of learning; for all learning is knowledge acquired, and all knowledge in God is original: and therefore we must look for it by another name, that of wisdom or sapience, as the Scriptures call it.

It is so then, that in the work of the creation we see a double emanation of virtue from God; the one referring more properly to power, the other to wisdom; the one expressed in making the subsistence of the matter, and the other in disposing the beauty of the form. This being supposed, it is to be observed,

that, for any thing which appeareth in the history of the creation, the confused mass and matter of heaven and earth was made in a moment; and the order and disposition of that chaos, or mass, was the work of six days; such a note of difference it pleased God to put upon the works of power, and the works of wisdom: wherewith concurreth, that in the former it is not set down that God said, *Let there be heaven and earth*, as it is set down of the works following; but actually, that God made heaven and earth: the one carrying the stile of a manufacture, and the other of a law, decree, or council.

To proceed to that which is next in order, from God to spirits. We find, as far as credit is to be given to the celestial hierarchy of that supposed Dionysius the senator of Athens, the first place or degree is given to the angels of love, which are termed Seraphim, the second to the angels of light, which are termed Cherubim; and the third, and so following places, to thrones, principalities, and the rest, which are all angels of power and ministry; so as the angels of knowledge and illumination are placed before the angels of office and domination.

To descend from spirits and intellectual forms to sensible and material forms; we read the first form that was created was light, which hath a relation and correspondence in nature and corporal things to knowledge in spirits and incorporal things.

So in the distribution of days, we see, the day wherein God did rest, and contemplate his own works, was blessed above all the days wherein he did effect and accomplish them.

After the creation was finished, it is set down unto us, that man was placed in the garden to work therein; which work, so appointed to him, could be no other than work of contemplation; that is, when the end of work is but for exercise and experiment, not for necessity; for there being then no reluctation of the creature, nor sweat of the brow, man's em-

ployment must of consequence have been matter of delight in the experiment, and not matter of labour for the use. Again, the first acts which man performed in paradise, consisted of the two summary parts of knowledge; the view of creatures, and the imposition of names. As for the knowledge which induced the fall, it was, as was touched before, not the natural knowledge of creatures, but the moral knowledge of good and evil; wherein the supposition was, that God's commandments or prohibitions were not the originals of good and evil, but that they had other beginnings, which man aspired to know, to the end to make a total defection from God, and to depend wholly upon himself.

To pass on: in the first event or occurrence after the fall of man, we see, as the Scriptures have infinite mysteries, not violating at all the truth of the story or letter, an image of the two estates, the contemplative state, and the active state, figured in the two persons of Abel and Cain, and in the two simplest and most primitive trades of life, that of the shepherd, who, by reason of his leisure, rest in a place, and living in view of heaven, is a lively image of a contemplative life; and that of the husbandman: where we see again, the favour and election of God went to the shepherd, and not to the tiller of the ground.

So in the age before the flood, the holy records within those few memorials, which are there entered and registered, have vouchsafed to mention, and honour the name of the inventors and authors of music, and works in metal. In the age after the flood, the first great judgment of God upon the ambition of man was the confusion of tongues; whereby the open trade and intercourse of learning and knowledge was chiefly imbarred.

To descend to Moses the lawgiver, and God's first pen: he is adorned by the Scriptures with this addition and commendation, that he was *seen in all the learning of the Ægyptians;* which nation, we know,

was one of the most ancient schools of the world: for so Plato brings in the Ægyptian priest saying unto Solon: "You Grecians are ever children; you "have no knowledge of antiquity, nor antiquity of "knowledge." Take a view of the ceremonial law of Moses; you shall find, besides the prefiguration of Christ, the badge or difference of the people of God, the exercise and impression of obedience, and other divine uses and fruits thereof, that some of the most learned Rabbins have travelled profitably, and profoundly to observe, some of them a natural, some of them a moral sense, or reduction of many of the ceremonies and ordinances. As in the law of the leprosy, where it is said, *If the whiteness have overspread the flesh, the patient may pass abroad for clean; but if there be any whole flesh remaining, he is to be shut up for unclean:* one of them noteth a principle of nature, that putrefaction is more contagious before maturity, than after: and another noteth a position of moral philosophy, that men, abandoned to vice, do not so much corrupt manners, as those that are half-good and half-evil. So in this, and very many other places in that law, there is to be found, besides the theological sense, much aspersion of philosophy.

So likewise in that excellent book of Job, if it be revolved with diligence, it will be found pregnant, and swelling with natural philosophy; as for example, cosmography, and the roundness of the world: *Qui extendit aquilonem super vacuum, et appendit terram super nihilum;* wherein the pensileness of the earth, the pole of the north, and the finiteness or convexity of heaven are manifestly touched. So again, matter of astronomy; *Spiritus ejus ornavit cœlos, et obstetricante manu ejus eductus est Coluber tortuosus.* And in another place; *Nunquid conjungere valebis micantes stellas Pleiadas, aut gyrum Arcturi poteris dissipare?* Where the fixing of the stars, ever standing at equal distance, is with great elegancy noted. And in another place, *Qui facit Arcturum, et Oriona, et Hyadas, et interiora Austri;* where

again he takes knowledge of the depression of the southern pole, calling it the secrets of the south, because the southern stars were in that climate unseen. Matter of generation, *Annon sicut lac mulsisti me, et sicut caseum coagulasti me, etc.* Matter of minerals, *Habet argentum venarum suarum principia: et auro locus est in quo conflatur, ferrum de terra tollitur, et lapis solutus calore in æs vertitur;* and so forwards in that chapter.

So likewise in the person of Solomon the king, we see the gift or endowment of wisdom and learning, both in Solomon's petition, and in God's assent thereunto, preferred before all other terrene and temporal felicity. By virtue of which grant or donative of God, Solomon became enabled, not only to write those excellent parables, or aphorisms, concerning divine and moral philosophy; but also to compile a natural history of all verdure, from the cedar upon the mountain to the moss upon the wall, which is but a rudiment between putrefaction and an herb, and also of all things that breathe or move. Nay, the same Solomon the king, although he excelled in the glory of treasure and magnificent buildings, of shipping and navigation, of service and attendance, of fame and renown, and the like, yet he maketh no claim to any of those glories, but only to the glory of inquisition of truth; for so he saith expressly, *The glory of God is to conceal a thing, but the glory of the king is to find it out;* as if, according to the innocent play of children, the Divine Majesty took delight to hide his works, to the end to have them found out; and as if kings could not obtain a greater honour than to be God's playfellows in that game, considering the great commandment of wits and means, whereby nothing needeth to be hidden from them.

Neither did the dispensation of God vary in the times after our Saviour came into the world; for our Saviour himself did first shew his power to subdue ignorance, by his conference with the priests and doctors of the law, before he shewed his power to subdue nature by his miracles. And the coming of

the Holy Spirit was chiefly figured and expressed in the similitude and gift of tongues, which are but *vehicula scientiæ*.

So in the election of those instruments, which it pleased God to use for the plantation of the faith, notwithstanding that at the first he did employ persons altogeter unlearned, otherwise than by inspiration, more evidently to declare his immediate working, and to abase all human wisdom or knowledge; yet, nevertheless, that counsel of his was no sooner performed, but in the next vicissitude and succession, he did send his divine truth into the world, waited on with other learnings, as with servants or handmaids: for so we see St. Paul, who was only learned amongst the apostles, had his pen most used in the Scriptures of the New Testament.

So again, we find that many of the ancient bishops and fathers of the church were excellently read, and studied in all the learning of the heathen; insomuch, that the edict of the emperor Julianus, whereby it was interdicted unto Christians to be admitted into schools, lectures, or exercises of learning, was esteemed and accounted a more pernicious engine and machination against the Christian faith, than were all the sanguinary prosecutions of his predecessors; neither could the emulation and jealousy of Gregory the First of that name, bishop of Rome, ever obtain the opinion of piety or devotion; but contrariwise received the censure of humour, malignity, and pusillanimity, even amongst holy men; in that he designed to obliterate and extinguish the memory of heathen antiquity and authors. But contrariwise it was the Christian church, which, amidst the inundations of the Scythians on the one side from the north-west, and the Saracens from the east, did preserve, in the sacred lap and bosom thereof, the precious relicks even of heathen learning, which otherwise had been extinguished, as if no such thing had ever been.

And we see before our eyes, that in the age of ourselves and our fathers, when it pleased God to

call the church of Rome to account for their degenerate manners and ceremonies, and sundry doctrines obnoxious, and framed to uphold the same abuses; at one and the same time it was ordained by the divine providence, that there should attend withal a renovation, and new spring of all other knowledges: and, on the other side, we see the Jesuits, who partly in themselves, and partly by the emulation and provocation of their example, have much quickened and strengthened the state of learning: we see, I say, what notable service and reparation they have done to the Roman see.

Wherefore, to conclude this part, let it be observed, that there be two principal duties and services, besides ornament and illustration, which philosophy and human learning do perform to faith and religion. The one, because they are an effectual inducement to the exaltation of the glory of God. For as the Psalms and other Scriptures do often invite us to consider, and magnify the great and wonderful works of God; so if we should rest only in the contemplation of the exterior of them, as they first offer themselves to our senses, we should do a like injury unto the majesty of God, as if we should judge or construe of the store of some excellent jeweller, by that only which is set out toward the street in his shop. The other, because they minister a singular help and preservative against unbelief and error: for our Saviour sath, *You err, not knowing the Scriptures, nor the power of God;* laying before us two books or volumes to study, if we will be secured from error; first, the Scriptures, revealing the will of God; and then the creatures expressing his power: whereof the latter is a key unto the former: not only opening our understanding to conceive the true sense of the Scriptures, by the general notions of reason and rules of speech; but chiefly opening our belief, in drawing us into a due meditation of the omnipotency of God, which is chiefly signed and engraven upon his works. Thus much therefore for divine testimony and evidence, concerning the true dignity and value of learning.

As for human proofs, it is so large a field, as, in a discourse of this nature and brevity, it is fit rather to use choice of those things which we shall produce, than to embrace the variety of them. First, therefore, in the degrees of human honor amongst the heathen, it was the highest, to obtain to a veneration and adoration as a God. This unto the Christians is as the forbidden fruit. But we speak now separately of human testimony; according to which, that which the Grecians call *apotheosis*, and the Latins, *relatio inter divos*, was the supreme honor which man could attribute unto man; especially when it was given, not by a formal decree or act of state, as it was used among the Roman emperors, but by an inward assent and belief. Which honour being so high, had also a degree of middle term: for there were reckoned above human honors, honors heroical and divine: in the attribution and distribution of which honors, we see, antiquity made this difference: that whereas founders and uniters of states and cities, lawgivers, extirpers of tyrants, fathers of the people, and other eminent persons in civil merit, were honored but with the titles of worthies or demi-gods; such as were Hercules, Theseus, Minos, Romulus, and the like: on the other side, such as were inventors and authors of new arts, endowments, and commodities towards man's life, were ever consecrated amongst the gods themselves: as were Ceres, Bacchus, Mercurius, Apollo, and others; and justly: for the merit of the former is confined within the circle of an age or a nation; and is like fruitful showers, which though they be profitable and good, yet serve but for that season, and for a latitude of ground where they fall; but the other is indeed like the benefits of heaven, which are permanent and universal. The former, again, is mixed with strife and perturbation; but the latter hath the true character of divine presence, coming *in aura leni*, without noise or agitation.

Neither is certainly that other merit of learning, in repressing the inconveniencies which grow from man

to man, much inferior to the former, of relieving the necessities which arise from nature; which merit was lively set forth by the ancients in that feigned relation of Orpheus's theatre, where all beasts and birds assembled, and, forgetting their several appetites, some of prey, some of game, some of quarrel, stood all sociably together listening to the airs and accords of the harp; the sound whereof no sooner ceased, or was drowned by some louder noise, but every beast returned to his own nature: wherein is aptly described the nature and condition of men, who are full of savage and unreclaimed desires of profit, of lust, of revenge; which as long as they give ear to precepts, to laws, to religion, sweetly touched with eloquence and persuasion of books, of sermons, of harangues, so long is society and peace maintained; but if these instruments be silent, or that sedition and tumult make them not audible, all things dissolve into anarchy and confusion.

But this appeareth more manifestly, when kings themselves, or persons of authority under them, or other governors in commonwealths and popular estates, are endued with learning. For although he might be thought partial to his own profession, that said, "Then should people and estates be happy, "when either kings were philosophers, or philoso-"phers kings;" yet so much is verified by experience, that under learned princes and governors there have been ever the best times: for howsoever kings may have their imperfections in their passions and customs; yet if they be illuminated by learning, they have those notions of religion, policy, and morality, which do preserve them; and refrain them from all ruinous and peremptory errors and excesses, whispering evermore in their ears, when counsellors and servants stand mute and silent. And senators, or counsellors likewise, which be learned, do proceed upon more safe and substantial principles, than counsellors which are only men of experience; the one sort keeping dangers afar off, whereas the other discover them not till they come near hand, and

then trust to the agility of their wit to ward off or avoid them.

Which felicity of times under learned princes, to keep still the law of brevity, by using the most eminent and selected examples, doth best appear in the age which passed from the death of Domitian the emperor, until the reign of Commodus; comprehending a succession of six princes, all learned, or singular favourers and advancers of learning; which age, for temporal respects, was the most happy and flourishing that ever the Roman empire, which then was a model of the world, enjoyed; a matter revealed and prefigured unto Domitian in a dream the night before he was slain, for he thought there was grown behind upon his shoulders a neck and a head of gold: which came accordingly to pass in those golden times which succeeded; of which princes we will make some commemoration: wherein although the matter will be vulgar, and may be thought fitter for a declamation, than agreeable to a treatise enfolded as this is; yet because it is pertinent to the point in hand, *neque semper arcum tendit Apollo*, and to name them only were too naked and cursory, I will not omit it altogether.

The first was Nerva, the excellent temper of whose government is by a glance in Cornelius Tacitus touched to the life: *Postquam divus Nerva res olim insociabiles miscuisset, imperium et libertatem.* And in token of his learning, the last act of his short reign, left to memory, was a missive to his adopted son Trajan, proceeding upon some inward discontent at the ingratitude of the times, comprehended in a verse of Homer's;

Telis, Phœbe, tuis lacrymas ulciscere nostras.

Trajan, who succeeded, was for his person not learned: but if we will hearken to the speech of our Saviour, that saith, *He that receiveth a prophet in the name of a prophet, shall have a prophet's reward*, he deserveth to be placed amongst the most learned princes; for there was not a greater admirer of learning, or benefactor of learning; a founder of famous

libraries, a perpetual advancer of learned men to office, and a familiar converser with learned professors and preceptors, who were noted to have then most credit in court. On the other side, how much Trajan's virtue and government was admired and renowned, surely no testimony of grave and faithful history doth more lively set forth, than that legend tale of Gregorius Magnus, bishop of Rome, who was noted for the extreme envy he bore towards all heathen excellency; and yet he is reported, out of the love and estimation of Trajan's moral virtues, to have made unto God passionate and fervent prayers for the delivery of his soul out of hell; and to have obtained it, with a caveat, that he should make no more such petitions. In this prince's time also, the persecutions against the Christians received intermission, upon the certificate of Plinius Secundus, a man of excellent learning, and by Trajan advanced.

Adrian, his successor, was the most curious man that lived, and the most universal inquirer; insomuch as it was noted for an error in his mind, that he desired to comprehend all things, and not to reserve himself for the worthiest things; falling into the like humour that was long before noted in Philip of Macedon, who, when he would needs over-rule and put down an excellent musician, in an argument touching music, was well answered by him again, "God "forbid, Sir, saith he, that your fortune should be so "bad, as to know these things better than I." It pleased God likewise to use the curiosity of this emperor, as an inducement to the peace of his church in those days. For having Christ in veneration, not as a God or Saviour, but as a wonder or novelty; and having his picture in his gallery, matched it with Apollonius, with whom, in his vain imagination, he thought he had some conformity; yet it served the turn to allay the bitter hatred of those times against the christian name, so as the church had peace during his time. And for his government civil, although he did not attain to that of Trajan's, in the glory of arms, or perfection of justice; yet in

deserving of the weal of the subject he did exceed him. For Trajan erected many famous monuments and buildings, insomuch as Constantine the Great in emulation was wont to call him *Parietaria*, wall-flower, because his name was upon so many walls: but his buildings and works were more of glory and triumph than use and necessity. But Adrian spent his whole reign, which was peaceable, in a perambulation, or survey of the Roman empire; giving order, and making assignation where he went, for re-edifying of cities, towns, and forts decayed, and for cutting of rivers and streams, and for making bridges and passages, and for policying of cities and commonalties with new ordinances and constitutions, and granting new franchises and incorporations; so that his whole time was a very restoration of all the lapses and decays of former times.

Antoninus Pius, who succeeded him, was a prince excellently learned; and had the patient and subtle wit of a schoolman; insomuch as in common speech, which leaves no virtue untaxed, he was called *cymini sector*, a carver, or a divider of cumin seed, which is one of the least seeds; such a patience he had and settled spirit, to enter into the least and most exact differences of causes, a fruit no doubt of the exceeding tranquillity and serenity of his mind; which being no ways charged or incumbered, either with fears, remorses, or scruples, but having been noted for a man of the purest goodness, without all fiction or affectation, that hath reigned or lived, made his mind continually present and intire. He likewise approached a degree nearer unto christianity, and became, as Agrippa said unto St. Paul, *half a Christian*; holding their religion and law in good opinion, and not only ceasing persecution, but giving way to the advancement of Christians.

There succeeded him the first *divi fratres*, the two adoptive brethren, Lucius Commodus Verus, son to to Ælius Verus, who delighted much in the softer kind of learning, and was wont to call the poet Martial his Virgil: and Marcus Aurelius Antoninus,

whereof the latter, who obscured his colleague, and survived him long, was named the philosopher; who as he excelled all the rest in learning, so he excelled them likewise in perfection of all royal virtues; insomuch as Julianus the emperor, in his book, intitled *Cæsares*, being as a pasquil or satire to deride all his predecessors, feigned, that they were all invited to a banquet of the gods, and Silenus the Jester sat at the nether end of the table, and bestowed a scoff on every one as they came in; but when Marcus Philosophus came in, Silenus was gravelled, and out of countenance, not knowing where to carp at him, save at the last he gave a glance at his patience towards his wife. And the virtue of this prince, continued with that of his predecessor, made the name of Antoninus so sacred in the world, that though it were extremely dishonoured in Commodus, Caracalla, and Heliogabalus, who all bore the name; yet when Alexander Severus refused the name, because he was a stranger to the family, the Senate with one acclamation said, *Quo modo Augustus, sic et Antoninus.* In such renown and veneration was the name of these two princes in those days, that they would have had it as a perpetual addition in all the emperors stiles. In this emperor's time also, the church for the most part was in peace; so as in this sequence of six princes, we do see the blessed effects of learning in sovereignty, painted forth in the greatest table of the world.

But for a tablet, or picture of smaller volume, not presuming to speak of your majesty that liveth, in my judgment the most excellent is that of queen Elizabeth, your immediate predecessor in this part of Britain; a princess that, if Plutarch were now alive to write lives by parallels, would trouble him, I think, to find for her a parallel amongst women. This lady was endued with learning in her sex singular, and great even amongst masculine princes; whether we speak of learning, of language, or of science, modern or ancient, divinity or humanity: and unto the very last year of her life, she accustomed to appoint set hours for reading; scarcely any young student in an

university, more daily, or more duly. As for her government, I assure myself, I shall not exceed, if I do affirm, that this part of the island never had forty-five years of better times; and yet not through the calmness of the season, but through the wisdom of her regimen.

For if there be considered of the one side, the truth of religion established; the constant peace and security; the good administration of justice; the temperate use of the prerogative, not slackened, nor much strained; the flourishing state of learning, sortable to so excellent a patroness; the convenient estate of wealth and means, both of crown and subject; the habit of obedience, and the moderation of discontents: and there be considered, on the other side, the differences of religion, the troubles of neighbour countries, the ambition of Spain, and opposition of Rome; and then, that she was solitary, and of herself: these things, I say, considered, as I could not have chosen an instance so recent and so proper, so, I suppose, I could not have chosen one more remarkable or eminent to the purpose now in hand, which is concerning the conjunction of learning in the prince, with felicity in the people.

Neither hath learning an influence and operation only upon civil merit and moral virtue, and the arts or temperature of peace and peaceable government; but likewise it hath no less power and efficacy in enablement towards martial and military virtue and prowess; as may be notably represented in the examples of Alexander the great, and Cæsar the dictator, mentioned before, but now in fit place to be resumed; of whose virtues and acts in war there needs no note or recital, having been the wonders of time in that kind: but of their affections towards learning, and perfections in learning, it is pertinent to say somewhat.

Alexander was bred and taught under Aristotle the great philosopher, who dedicated divers of his books of philosophy unto him: he was attended with Callisthenes, and divers other learned persons, that

followed him in camp, throughout his journeys and conquests. What price and estimation he had learning in, doth notably appear in these three particulars: first, in the envy he used to express that he bore towards Achilles, in this, that he had so good a trumpet of his praises as Homer's verses: secondly, in the judgment or solution he gave touching that precious cabinet of Darius, which was found amongst his jewels, whereof question was made what thing was worthy to be put into it, and he gave his opinion for Homer's works: thirdly, in his letter to Aristotle, after he had set forth his books of nature, wherein he expostulateth with him for publishing the secrets or mysteries of philosophy; and gave him to understand that himself esteemed it more to excel other men in learning and knowledge, than in power and empire. And what use he had of learning doth appear, or rather shine, in all his speeches and answers, being full of science and use of science, and that in all variety.

And here again it may seem a thing scholastical, and somewhat idle, to recite things that every man knoweth; but yet, since the argument I handle leadeth me thereunto, I am glad that men shall perceive I am as willing to flatter, if they will so call it, an Alexander, or a Cæsar, or an Antoninus, that are dead many hundred years since, as any that now liveth: for it is the displaying the glory of learning in sovereignty that I propound to myself, and not an humour of declaiming in any man's praises. Observe then the speech he used of Diogenes, and see if it tend not to the true state of one of the greatest questions of moral philosophy; whether the enjoying of outward things, or the contemning of them, be the greatest happiness: for when he saw Diogenes so perfectly contented with so little, he said to those that mocked at his condition; "Were I not Alexander, I would wish to be Diogenes." But Seneca inverteth it, and saith; *Plus erat, quod hic nollet accipere, quàm quod ille posset dare.* "There were "more things which Diogenes would have refused, "than those were, which Alexander could have given "or enjoyed."

Observe again that speech which was usual with him, "That he felt his mortality chiefly in two things, "sleep and lust;" and see if it were not a speech extracted out of the depth of natural philosophy, and liker to have come out of the mouth of Aristotle, or Democritus, than from Alexander.

See again that speech of humanity and poesy; when upon the bleeding of his wounds, he called unto him one of his flatterers, that was wont to ascribe to him divine honor, and said, "Look, this is very blood; "this is not such liquor as Homer speaketh of, which "ran from Venus's hand, when it was pierced by "Diomedes."

See likewise his readiness in reprehension of logic, in the speech he used to Cassander, upon a complaint that was made against his father Antipater: for when Alexander happened to say, "Do you think "these men would have come from so far to com-"plain, except they had just cause of grief?" And Cassander answered, "Yea, that was the matter, be-"cause they thought they should not be disproved." Said Alexander laughing: "See the subtilties of "Aristotle, to take a matter both ways, *pro et contra*," etc.

But note again how well he could use the same art, which he reprehended, to serve his own humour, when bearing a secret grudge to Callisthenes, because he was against the new ceremony of his adoration, feasting one night, where the same Callisthenes was at the table, it was moved by some after supper, for entertainment sake, that Callisthenes, who was an eloquent man, might speak of some theme or purpose, at his own choice: which Callisthenes did; choosing the praise of the Macedonian nation for his discourse, and performing the same with so good manner, as the hearers were much ravished: whereupon Alexander, nothing pleased, said, "It was easy "to be eloquent upon so good a subject. But," saith he, "turn your stile, and let us hear what you can say "against us:" which Callisthenes presently undertook, and did with that sting and life, that Alexander

interrupted him, and said, " The goodness of the cause " made him eloquent before, and despite made him " eloquent then again."

Consider farther, for tropes of rhetoric, that excellent use of a metaphor or translation, wherewith he taxed Antipater, who was an imperious and tyrannous governor: for when one of Antipater's friends commended him to Alexander for his moderation, that he did not degenerate, as his other lieutenants did, into the Persian pride in use of purple, but kept the ancient habit of Macedon, of black: " True," saith Alexander, " but Antipater is all purple within." Or that other, when Parmenio came to him in the plain of Arbela, and shewed him the innumerable multitude of his enemies, especially as they appeared by the infinite number of lights, as it had been a new firmament of stars, and thereupon advised him to assail them by night: whereupon he answered, " That he " would not steal the victory."

For matter of policy weigh that significant distinction, so much in all ages embraced, that he made between his two friends, Hephæstion and Craterus, when he said, " That the one loved Alexander, and " the other loved the king:" describing the principal difference of princes best servants, that some in affection love their person, and others in duty love their crown.

Weigh also that excellent taxation of an error, ordinary with counsellors of princes, that they counsel their masters according to the model of their own mind and fortune, and not of their masters; when, upon Darius's great offers, Parmenio had said, " Surely " I would accept these offers, were I as Alexan- " der;" saith Alexander, " So would I, were I as " Parmenio."

Lastly, weigh that quick and acute reply, which he made when he gave so large gifts to his friends and servants, and was asked what he did reserve for himself, and he answered, " Hope:" weigh, I say, whether he had not cast up his account right, because hope must be the portion of all that resolve upon

great enterprises. For this was Cæsar's portion when he went first into Gaul, his estate being then utterly overthrown with largesses. And this was likewise the portion of that noble prince, howsoever transported with ambition, Henry duke of Guise, of whom it was usually said, that he was the greatest usurer in France, because he had turned all his estate into obligations.

To conclude therefore: as certain critics are used to say hyperbolically, "That if all sciences were lost, "they might be found in Virgil;" so certainly this may be said truly, there are the prints and footsteps of all learning in those few speeches which are reported of this prince: the admiration of whom, when I consider him not as Alexander the great, but as Aristotle's scholar, hath carried me too far.

As for Julius Cæsar, the excellency of his learning needeth not to be argued from his education, or his company, or his speeches; but in a farther degree doth declare itself in his writings and works; whereof some are extant and permanent, and some unfortunately perished. For, first, we see, there is left unto us that excellent history of his own wars, which he intitled only a commentary, wherein all succeeding times have admired the solid weight of matter, and the real passages, and lively images of actions and persons, expressed in the greatest propriety of words and perspicuity of narration that ever was; which that it was not the effect of a natural gift, but of learning and precept, is well witnessed by that work of his, intitled, *De analogia*, being a grammatical philosophy, wherein he did labour to make this same *vox ad placitum* to become *vox ad licitum*, and to reduce custom of speech to congruity of speech; and took, as it were, the picture of words from the life of reason.

So we receive from him, as a monument both of his power and learning, the then reformed computation of the year; well expressing, that he took it to be as great a glory to himself to observe and know the law of the heavens, as to give law to men upon the earth.

So likewise in that book of his, *Anti-Cato*, it may easily appear that he did aspire as well to victory of wit as victory of war; undertaking therein a conflict against the greatest champion with the pen that then lived, Cicero the orator.

So again in his book of *Apophthegms*, which he collected, we see that he esteemed it more honor to make himself but a pair of tables, to take the wise and pithy words of others, than to have every word of his own to be made an apophthegm, or an oracle; as vain princes, by custom of flattery, pretend to do. And yet if I should enumerate divers of his speeches, as I did those of Alexander, they are truly such as Solomon noteth, when he saith, *Verba sapientum tanquam aculei, et tanquam clavi in altum defixi:* whereof I will only recite three, not so delectable for elegancy, but admirable for vigour and efficacy.

As first, it is reason he be thought a master of words, that could with one word appease a mutiny in his army, which was thus: The Romans, when their generals did speak to their army, did use the word *Milites*, but when the magistrates spake to the people, they did use the word *Quirites*. The soldiers were in tumult, and seditiously prayed to be cashiered; not that they so meant, but by expostulation thereof to draw Cæsar to other conditions; wherein he being resolute not to give way, after some silence, he began his speech, *Ego, Quirites:* which did admit them already cashiered; wherewith they were so surprised, crossed, and confused, as they would not suffer him to go on in his speech, but relinquished their demands, and made it their suit, to be again called by the name of *Milites*.

The second speech was thus: Cæsar did extremely affect the name of king; and some were set on, as he passed by, in popular acclamation to salute him king; whereupon, finding the cry weak and poor, he put it off thus, in a kind of jest, as if they had mistaken his surname; *Non rex sum, sed Cæsar;* a speech, that if it be searched, the life and fulness of it can scarce be expressed: for, first, it was a refusal of the name,

but yet not serious: again, it did signify an infinite confidence and magnanimity, as if he presumed Cæsar was the greater title, as by his worthiness it is come to pass till this day: but chiefly, it was a speech of great allurement toward his own purpose; as if the state did strive with him but for a name, whereof mean families were vested; for Rex was a surname with the Romans, as well as King is with us.

The last speech which I will mention, was used to Metellus; when Cæsar, after war declared, did possess himself of the city of Rome, at which time entering into the inner treasury to take the money there accumulated, Metellus, being tribune, forbad him: whereto Cæsar said, "That if he did not desist, he "would lay him dead in the place." And presently taking himself up, he added, "Young man, it is "harder for me to speak it, than to do it;" *Adolescens, durius est mihi hoc dicere, quàm facere.* A speech compounded of the greatest terror and greatest clemency that could proceed out of the mouth of man.

But to return, and conclude with him: it is evident, himself knew well his own perfection in learning, and took it upon him; as appeared when, upon occasion that some spake what a strange resolution it was in Lucius Sylla to resign his dictature; he scoffing at him, to his own advantage, answered, "That Sylla "could not skill of letters, and therefore knew not "how to dictate."

And here it were fit to leave this point, touching the concurrence of military virtue and learning, for what example would come with any grace, after those two of Alexander and Cæsar? were it not in regard of the rareness of circumstance, that I find in one particular, as that which did so suddenly pass from extreme scorn to extreme wonder; and it is of Xenophon the philosopher, who went from Socrates's school into Asia, in the expedition of Cyrus the younger, against king Artaxerxes. This Xenophon at that time was very young, and never had seen the wars before; neither had any command in the army, but only followed the war as a voluntary, for the love and conversation of Proxenus his friend. He was

present when Falinus came in message from the great king to the Grecians, after that Cyrus was slain in the field, and they a handful of men left to themselves in the midst of the king's territories, cut off from their country by many navigable rivers, and many hundred miles. The message imported, that they should deliver up their arms, and submit themselves to the king's mercy. To which message before answer was made, divers of the army conferred familiarly with Falinus: and amongst the rest Xenophon happened to say, "Why, Falinus, we have now but "these two things left, our arms and our virtue? "and if we yield up our arms, how shall we make "use of our virtue?" Whereto Falinus, smiling on him, said, "If I be not deceived, young gentleman, "you are an Athenian, and, I believe, you study "philosophy, and it is pretty that you say; but you "are much abused, if you think your virtue can "withstand the king's power." Here was the scorn; the wonder followed; which was, that this young scholar, or philosopher, after all the captains were murdered in parley by treason, conducted those ten thousand foot, through the heart of all the king's high countries, from Babylon to Græcia in safety, in despite of all the king's forces, to the astonishment of the world, and the encouragement of the Grecians in time succeeding to make invasion upon the kings of Persia; as was after purposed by Jason the Thessalian, attempted by Agesilaus the Spartan, and atchieved by Alexander the Macedonian, all upon the ground of the act of that young scholar.

To proceed now from imperial and military virtue to moral and private virtue: first, it is an assured truth, which is contained in the verses;

Scilicet ingenuas didicisse fideliter artes,
Emollit mores, nec sinit esse feros.

It taketh away the wildness and barbarism, and fierceness of mens minds: but indeed the accent had need be upon *fideliter*: for a little superficial learning doth rather work a contrary effect. It taketh away all levity, temerity, and insolency, by copious suggestion of all doubts and difficulties, and acquainting

the mind to balance reasons on both sides, and to turn back the first offers and conceits of the mind, and to accept of nothing but examined and tried. It taketh away vain admiration of any thing, which is the root of all weakness: for all things are admired, either because they are new, or because they are great. For novelty, no man that wadeth in learning or contemplation throughly, but will find that printed in his heart *Nil novi super terram.* Neither can any man marvel at the play of puppets, that goeth behind the curtain, and adviseth well of the motion. And for magnitude, as Alexander the Great, after that he was used to great armies, and the great conquests of the spacious provinces in Asia, when he received letters out of Greece, of some fights and services there, which were commonly for a passage, or a fort, or some walled town at the most, he said, "It seemed to him, that he was advertised of the "battle of the frogs and the mice, that the old tales "went of." So certainly, if a man meditate upon the universal frame of nature, the earth with men upon it, the divineness of souls excepted, will not seem much other than an ant-hill, where some ants carry corn, and some carry their young, and some go empty, and all to and fro a little heap of dust. It taketh away or mitigateth fear of death, or adverse fortune; which is one of the greatest impediments of virtue and imperfections of manners. For if a man's mind be deeply seasoned with the consideration of the mortality and corruptible nature of things, he will easily concur with Epictetus, who went forth one day, and saw a woman weeping for her pitcher of earth that was broken; and went forth the next day, and saw a woman weeping for her son that was dead; and thereupon said, *Heri vidi fragilem frangi, hodie vidi mortalem mori.* And therefore Virgil did excellently and profoundly couple the knowledge of causes, and the conquest of all fears together, as *concomitantia:*

Felix, qui potuit rerum cognoscere causas,
Quique metus omnes, et inexorabile fatum
Subjecit pedibus, strepitumque Acherontis avari.

It were too long to go over the particular remedies which learning doth minister to all the diseases of the mind, sometimes purging the ill-humours, sometimes opening the obstructions, sometimes helping digestion, sometimes increasing appetite, sometimes healing the wounds and exulcerations thereof, and the like; and therefore I will conclude with that which hath *rationem totius*, which is, that it disposeth the constitution of the mind not to be fixed or settled in the defects thereof, but still to be capable and susceptible of growth and reformation. For the unlearned man knows not what it is to descend into himself, or to call himself to account; nor the pleasure of that *suavissima vita, indies sentire se fieri meliorem.* The good parts he hath, he will learn to shew to the full, and use them dexterously, but not much to increase them: the faults he hath, he will learn how to hide and colour them, but not much to amend them: like an ill mower, that mows on still, and never whets his scythe. Whereas with the learned man it fares otherwise, that he doth ever intermix the correction and amendment of his mind, with the use and employment thereof. Nay, farther, in general and in sum certain it is, that *veritas* and *bonitas* differ but as the seal and the print: for truth prints goodness; and they be the clouds of error, which descend in the storms of passions and perturbations.

From moral virtue let us pass on to matter of power and commandment, and consider whether in right reason there be any comparable with that, wherewith knowledge investeth and crowneth man's nature. We see the dignity of the commandment is according to the dignity of the commanded: to have commandment over beasts, as herdmen have, is a thing contemptible; to have commandment over children, as schoolmasters have, is a matter of small honor; to have commandment over galley slaves, is a disparagement, rather than an honor. Neither is the commandment of tyrants much better, over people which have put off the generosity of their minds:

and therefore it was ever holden, that honors in free monarchies and commonwealths had a sweetness more than in tyrannies, because the commandment extendeth more over the wills of men, and not only over their deeds and services. And therefore, when Virgil putteth himself forth to attribute to Augustus Cæsar the best of human honors, he doth it in these words:

victorque volentes
Per populos dat jura, viamque affectat Olympo.

But yet the commandment of knowledge is higher than the commandment over the will; for it is a commandment over the reason, belief and understanding of man, which is the highest part of the mind, and giveth law to the will itself: for there is no power on earth, which setteth up a throne, or chair of state, in the spirits and souls of men, and in their cogitations, imaginations, opinions, and beliefs, but knowledge and learning. And therefore we see the detestable and extreme pleasure that arch-heretics, and false prophets, and impostors are transported with, when they once find in themselves that they have a superiority in the faith and conscience of men; so great, as, if they have once tasted of it, it is seldom seen that any torture or persecution can make them relinquish or abandon it. But as this is what the author of the *Revelation* calleth *the depth*, or profoundness, *of Satan*; so, by argument of contraries, the just and lawful sovereignty over men's understanding, by force of truth rightly interpreted, is that which approacheth nearest to the similitude of the divine rule.

As for fortune and advancement, the beneficence of learning is not so confined to give fortune only to states and commonwealths, as it doth not likewise give fortune to particular persons. For it was well noted long ago, that Homer hath given more men their livings, than either Sylla, or Cæsar, or Augustus ever did, notwithstanding their great largesses and donatives, and distributions of lands to so many legions; and no doubt it is hard to say, whether arms

or learning have advanced greater numbers. And in case of sovereignty we see, that if arms or descent have carried away the kingdom, yet learning hath carried the priesthood, which ever hath been in some competition with empire.

Again, for the pleasure and delight of knowledge and learning, it far surpasseth all other in nature: for, shall the pleasures of the affections so exceed the pleasures of the senses, as much as the obtaining of desire or victory exceedeth a song or a dinner; and must not, of consequence, the pleasures of the intellect, or understanding, exceed the pleasures of the affections? We see in all other pleasures there is satiety, and after they be used, their verdure departeth; which sheweth well they be but deceits of pleasure, and not pleasures; and that it was the novelty which pleased, and not the quality: and therefore we see that voluptuous men turn friers, and ambitious princes turn melancholy. But of knowledge there is no satiety, but satisfaction and appetite are perpetually interchangeable; and therefore appeareth to be good in itself simply, without fallacy or accident. Neither is that pleasure of small efficacy and contentment to the mind of man, which the poet Lucretius describeth elegantly,

Suave mari magno, turbantibus æquora ventis, etc.

"It is a view of delight, saith he, to stand or walk "upon the shore side, and to see a ship tossed with "tempest upon the sea; or to be in a fortified tower, "and to see two battles join upon a plain; but it is a "pleasure incomparable, for the mind of man to be "settled, landed, and fortified in the certainty of "truth, and from thence to descry and behold the "errors, perturbations, labours, and wanderings up "and down of other men."

Lastly, leaving the vulgar arguments, that by learning man excelleth man in that wherein man excelleth beasts; that by learning man ascendeth to the heavens and their motions, where in body he cannot come, and the like: let us conclude with the dignity and excellency of knowledge and learning in that where-

unto man's nature doth most aspire, which is, immortality or continuance: for to this tendeth generation, and raising of houses and families; to this tend buildings, foundations, and monuments; to this tendeth the desire of memory, fame, and celebration, and in effect the strength of all other human desires. We see then how far the monuments of wit and learning are more durable than the monuments of power, or of the hands. For have not the verses of Homer continued twenty-five hundred years, or more, without the loss of a syllable or letter; during which time, infinite palaces, temples, castles, cities, have been decayed and demolished? It is not possible to have the true pictures or statues of Cyrus, Alexander, and Cæsar; no, nor of the kings or great personages of much later years; for the originals cannot last, and the copies cannot but lose of the life and truth. But the images of mens wits and knowledges remain in books, exempted from the wrong of time, and capable of perpetual renovation. Neither are they fitly to be called images, because they generate still, and cast their seeds in the minds of others, provoking and causing infinite actions and opinions in succeeding ages: so that, if the invention of the ship was thought so noble, which carrieth riches and commodities from place to place, and consociateth the most remote regions in participation of their fruits; how much more are letters to be magnified, which, as ships, pass through the vast seas of time, and make ages so distant to participate of the wisdom, illuminations, and inventions, the one of the other? Nay farther, we see, some of the philosophers which were least divine, and most immersed in the senses, and denied generally the immortality of the soul; yet came to this point, that whatsoever motions the spirit of man could act and perform without the organs of the body, they thought, might remain after death, which were only those of the understanding, and not of the affections; so immortal and incorruptible a thing did knowledge seem unto them to be. But we, that know by divine revelation,

that not only the understanding, but the affections purified; not only the spirit, but the body changed, shall be advanced to immortality, do disclaim these rudiments of the senses. But it must be remembered both in this last point, and so it may likewise be needful in other places, that in probation of the dignity of knowledge or learning, I did in the beginning separate divine testimony from human, which method I have pursued, and so handled them both apart.

Nevertheless I do not pretend, and I know it will be impossible for me, by any pleading of mine, to reverse the judgment, either of Æsop's cock, that preferred the barley-corn before the gem; or of Midas, that being chosen judge between Apollo, president of the Muses, and Pan, god of the flocks, judged for plenty; or of Paris, that judged for beauty and love, against wisdom and power; or of Agrippina, *occidat matrem, modo imperet*, that preferred empire with any condition never so detestable; or of Ulysses, *qui vetulam prætulit immortalitati*, being a figure of those which prefer custom and habit before all excellency; or of a number of the like popular judgments. For these things must continue as they have been: but so will that also continue whereupon learning hath ever relied, and which faileth not: *iustificata est Sapientia à filiis suis.*

THE

SECOND BOOK OF FRANCIS BACON:

OF THE

PROFICIENCE AND ADVANCEMENT

OF

LEARNING, DIVINE AND HUMAN.

TO THE KING.

IT might seem to have more convenience, though it come often otherwise to pass, excellent king, that those, which are fruitful in their generations, and have in themselves the foresight of immortality in their descendants, should likewise be more careful of the good estate of future times, unto which they know they must transmit and commend over their dearest pledges. Queen Elizabeth was a sojourner in the world, in respect of her unmarried life, and was a blessing to her own times; and yet so as the impression of her good government, besides her happy memory, is not without some effect which doth survive her. But to your majesty, whom God hath already blessed with so much royal issue, worthy to continue and represent you for ever; and whose youthful and fruitful bed doth yet promise many the like renovations; it is proper and agreeable to be conversant, not only in the transitory parts of good government, but in those acts also which are in their nature permanent and perpetual: among the which, if affection do not transport me, there is not any more worthy, than the farther endowment of the world with sound and fruitful knowledge. For why should a few received authors stand up like Hercules's

columns; beyond which there should be no sailing or discovering, since we have so bright and benign a star as your majesty, to conduct and prosper us? To return therefore where we left, it remaineth to consider of what kind those acts are, which have been undertaken and performed by kings and others for the increase and advancement of learning: wherein I purpose to speak actively, without digressing or dilating.

Let this ground therefore be laid, that all works are overcome by amplitude of reward, by soundness of direction, and by the conjunction of labours. The first multiplieth endeavour, the second preventeth error, and the third supplieth the frailty of man; but the principal of these is direction: for *claudus in via antevertit cursorem extra viam;* and Solomon excellently setteth it down, *If the iron be not sharp, it requireth more strength; but wisdom is that which prevaileth:* signifying, that the invention or election of the mean is more effectual than any inforcement or accumulation of endeavours. This I am induced to speak, for that, not derogating from the noble intention of any that have been deservers towards the state of learning, I do observe, nevertheless, that their works and acts are rather matters of magnificence and memory, than of progression and proficience, and tend rather to augment the mass of learning, in the multitude of learned men, than to rectify or raise the sciences themselves.

The works or acts of merit towards learning are conversant about three objects: the places of learning, the books of learning, and the persons of the learned. For as water, whether it be the dew of heaven, or the springs of the earth, doth scatter and lose itself in the ground, except it be collected into some receptacle, where it may by union comfort and sustain itself, and for that cause the industry of man hath made and framed spring-heads, conduits, cisterns, and pools, which men have accustomed likewise to beautify and adorn with accomplishments of magnificence and state, as well as of use and necessity; so this excel-

lent liquor of knowledge, whether it descend from divine inspiration, or spring from human sense, would soon perish and vanish to oblivion, if it were not preserved in books, traditions, conferences, and places appointed; as universities, colleges, and schools, for the receipt and comforting of the same.

The works, which concern the seats and places of learning, are four; foundations and buildings, endowments with revenues, endowments with franchises and privileges, institutions and ordinances for government; all tending to quietness and privateness of life, and discharge of cares and troubles; much like the stations which Virgil prescribeth for the hiving of bees:

Principio sedes apibus statioque petenda,
Quo neque sit ventis aditus, etc.

The works touching books are two; first libraries, which are as the shrines where all the relicks of the ancient saints, full of true virtue, and that without delusion or imposture, are preserved and reposed: secondly, new editions of authors, with more correct impressions, more faithful translations, more profitable glosses, more diligent annotations, and the like.

The works pertaining to the persons of learned men, besides the advancement and countenancing of them in general, are two: the reward and designation of readers in sciences already extant and invented; and the reward and designation of writers and inquirers concerning any parts of learning not sufficiently laboured and prosecuted.

These are summarily the works and acts, wherein the merits of many excellent princes and other worthy personages have been conversant. As for any particular commemorations, I call to mind what Cicero said, when he gave general thanks; *Difficile non aliquem, ingratum quenquam præterire.* Let us rather, according to the Scriptures, look unto that part of the race which is before us, than look back to that which is already attained.

First therefore, amongst so many great foundations of colleges in Europe, I find strange that they are

all dedicated to professions, and none left free to arts and sciences at large. For if men judge that learning should be referred to action, they judge well; but in this they fall into the error described in the ancient fable, in which the other parts of the body did suppose the stomach had been idle, because it neither performed the office of motion, as the limbs do, nor of sense, as the head doth; but yet, notwithstanding, it is the stomach that digesteth and distributeth to all the rest: so if any man think philosophy and universality to be idle studies, he doth not consider that all professions are from thence served and supplied. And this I take to be a great cause, that hath hindered the progression of learning, because these fundamental knowledges have been studied but in passage. For if you will have a tree bear more fruit than it hath used to do, it is not any thing you can do to the boughs, but it is the stirring of the earth, and putting new mould about the roots, that must work it. Neither is it to be forgotten, that this dedicating of foundations and donations to professory learning, hath not only had a malign aspect and influence upon the growth of sciences, but hath also been prejudicial to states and governments. For hence it proceedeth that princes find a solitude in regard of able men to serve them in causes of state, because there is no education collegiate which is free, where such as were so disposed might give themselves to histories, modern languages, books of policy and civil discourse, and other the like enablements unto service of state.

And because founders of colleges do plant, and founders of lectures do water, it followeth well in order, to speak of the defect which is in public lectures; namely, in the smallness and meanness of the salary or reward which in most places is assigned unto them; whether they be lectures of arts, or of professions. For it is necessary to the progression of sciences, that readers be of the most able and sufficient men, as those which are ordained for generating and propagating of sciences, and not for transitory

use. This cannot be, except their condition and endowment be such as may content the ablest man to appropriate his whole labour, and continue his whole age in that function and attendance, and therefore must have a proportion answerable to that mediocrity or competency of advancement, which may be expected from a profession, or the practice of a profession. So as, if you will have sciences flourish, you must observe David's military law, which was, "That those which staid with the carriage, should have equal part with those which "were in the action;" else will the carriages be ill attended. So readers in sciences are indeed the guardians of the stores and provisions of sciences, whence men in active courses are furnished, and therefore ought to have equal entertainment with them; otherwise if the fathers in sciences be of the weakest sort, or be ill-maintained,

Et patrum invalidi referent jejunia nata.

Another defect I note, wherein I shall need some alchemist to help me, who call upon men to sell their books, and to build furnaces, quitting and forsaking Minerva and the Muses as barren virgins, and relying upon Vulcan. But certain it is, that unto the deep, fruitful, and operative study of many sciences, especially natural philosophy and physic, books be not only the instrumentals wherein also the beneficence of men hath not been altogether wanting: for, we see, spheres, globes, astrolabes, maps, and the like, have been provided as appurtenances to astronomy and cosmography, as well as books; we see likewise, that some places instituted for physic have annexed the commodity of gardens for simples of all sorts, and do likewise command the use of dead bodies for anatomies. But these do respect but a few things. In general, there will hardly be any main proficience in the disclosing of nature, except there be some allowances for expences about experiments; whether they be experiments appertaining to Vulcanus or Dædalus, furnace or engine, or any other kind; and therefore as secretaries and

spies of princes and states bring in bills for intelligence, so you must allow the spies and intelligencers of nature to bring in their bills, or else you shall be ill advertised.

And if Alexander made such a liberal assignation to Aristotle of treasure for the allowance of hunters, fowlers, fishers, and the like, that he might compile an history of nature, much better do they deserve it that travel in arts of nature.

Another defect which I note, is an intermission or neglect, in those which are governors in universities, of consultation; and in princes, or superior persons, of visitation: to enter into account and consideration, whether the readings, exercises, and other customs appertaining unto learning, anciently begun, and since continued, be well instituted or no, and thereupon to ground an amendment or reformation in that which shall be found inconvenient. For it is one of your majesty's own most wise and princely maxims, "That in all usages and precedents, the times be considered wherein they first began, which if they were weak or ignorant, it derogateth from the authority of the usage, and leaveth it for suspect." And therefore in as much as most of the usages and orders of the universities were derived from more obscure times, it is the more requisite they be re-examined. In this kind I will give an instance or two, for example sake, of things that are the most obvious and familiar: the one is a matter, which though it be ancient and general, yet I hold it to be an error, which is, that scholars in universities come too soon and too unripe to logic and rhetoric, arts fitter for graduates than children and novices; for these two, rightly taken, are the gravest of sciences, being the arts of arts, the one for judgment, the other for ornament. And they be the rules and directions how to set forth and dispose matter; and therefore for minds empty and unfraught with matter, and which have not gathered that which Cicero calleth *sylva* and *supellex*, stuff and variety, to begin with those arts, as if one should

learn to weigh, or to measure, or to paint the wind, doth work but this effect, that the wisdom of those arts, which is great and universal, is almost made contemptible, and is degenerate into childish sophistry and ridiculous affectation. And farther, the untimely learning of them hath drawn on, by consequence, the superficial and unprofitable teaching and writing of them, as fittest indeed to the capacity of children. Another, is a lack I find in the exercises used in the universities, which do make too great a divorce between invention and memory; for their speeches are either premeditate *in verbis conceptis*, where nothing is left to invention; or merely extemporal, where little is left to memory; whereas in life and action there is least use of either of these, but rather of intermixtures of premeditation and invention, notes and memory; so as the exercise fitteth not the practice, nor the image the life; and it is ever a true rule in exercises, that they be framed as near as may be to the life of practice, for otherwise they do pervert the motions and faculties of the mind, and not prepare them. The truth whereof is not obscure, when scholars come to the practices of professions, or other actions of civil life, which when they set into, this want is soon found by themselves, and sooner by others. But this part, touching the amendment of the institutions and orders of universities, I will conclude with the clause of Cæsar's letter to Appius and Balbus, *Hoc quemadmodum fieri possit, nonnulla mihi in mentem veniunt, et multa reperiri possunt: de iis rebus rogo vos, ut cogitationem suscipiatis.*

Another defect, which I note, ascendeth a little higher than the precedent; for as the proficience of learning consisteth much in the orders and institutions of universities in the same states and kingdoms, so it would be yet more advanced, if there were more intelligence mutual between the universities of Europe than now there is. We see there be many orders and foundations, which though they be divided under several sovereignties and territories, yet they take themselves to have a kind of contract,

fraternity, and correspondence one with another, insomuch as they have provincials and generals. And surely as nature createth brotherhood in families, and arts mechanical contract brotherhoods in commonalties, and the anointment of God superinduceth a brotherhood in kings and bishops: so in like manner there cannot but be a fraternity in learning and illumination, relating to that paternity, which is attributed to God, who is called the father of illuminations or lights.

The last defect which I will note is, that there hath not been, or very rarely been, any public designation of writers or inquirers concerning such parts of knowledge, as may appear not to have been already sufficiently laboured or undertaken: unto which point it is an inducement to enter into a view and examination what parts of learning have been prosecuted, and what omitted; for the opinion of plenty is amongst the causes of want, and the great quantity of books maketh a shew rather of superfluity than lack; which surcharge, nevertheless, is not to be remedied by making no more books, but by making more good books, which, as the serpent of Moses, might devour the serpents of the enchanters.

The removing of all the defects formerly enumerated, except the last, and of the active part also of the last, which is the designation of writers, are *opera basilica;* towards which the endeavours of a private man may be but as an image in a cross-way, that may point at the way, but cannot go it. But the inducing part of the latter, which is the survey of learning, may be set forward by private travel: wherefore I will now attempt to make a general and faithful perambulation of learning, with an inquiry what parts thereof lie fresh and waste, and not improved and converted by the industry of man; to the end that such a plot, made and recorded to memory, may both minister light to any public designation, and also serve to excite voluntary endeavours: wherein nevertheless, my purpose is at this time to note only omissions and deficiencies, and not to make

any redargution of errors, or incomplete prosecutions; for it is one thing to set forth what ground lieth unmanured, and another thing to correct ill husbandry in that which is manured.

In the handling and undertaking of which work I am not ignorant what it is that I do now move and attempt, nor insensible of mine own weakness to sustain my purpose; but my hope is, that if my extreme love to learning carry me too far, I may obtain the excuse of affection; for that "it is not granted "to man to love and to be wise." But, I know well, I can use no other liberty of judgment than I must leave to others; and I, for my part, shall be indifferently glad either to perform myself, or accept from another, that duty of humanity; *Nam qui erranti comiter monstrat viam, etc.* I do foresee likewise, that of those things which I shall enter and register, as deficiencies and omissions, many will conceive and censure, that some of them are already done and extant; others to be but curiosities, and things of no great use; and others to be of too great difficulty, and almost impossibility to be compassed and effected: but for the two first, I refer myself to the particulars; for the last, touching impossibility, I take it, those things are to be held possible which may be done by some person, though not by every one; and which may be done by many, though not by any one; and which may be done in succession of ages, though not within the hour-glass of one man's life; and which may be done by public designation, though not by private endeavour.

But, notwithstanding, if any man will take to himself rather that of Solomon, *Dicit piger, Leo est in via,* than that of Virgil, *Possunt quia posse videntur:* I shall be content that my labours be esteemed but as the better sort of wishes; for as it asketh some knowledge to demand a question not impertinent, so it requireth some sense to make a wish not absurd.

THE parts of human learning have reference to the three parts of man's Understanding, which is the seat of learning: History to his Memory, Poesy to his Imagination, and Philosophy to his Reason. Divine learning receiveth the same distribution, for the spirit of man is the same, though the revelation of oracle and sense be diverse: so as theology consisteth also of history of the church; of parables, which is divine poesy; and of holy doctrine or precept: for as for that part which seemeth supernumerary, which is prophecy, it is but divine history; which hath that prerogative over human, as the narration may be before the fact, as well as after.

Historia literarum.

HISTORY is *Natural, Civil, Ecclesiastical,* and *Literary;* whereof the three first I allow as extant, the fourth I note as deficient. For no man hath propounded to himself the general state of learning to be described and represented from age to age, as many have done the works of nature, and the state civil and ecclesiastical; without which the history of the world seemeth to me to be as the statue of Polyphemus with his eye out, that part being wanting which doth most shew the spirit and life of the person: And yet I am not ignorant, that in divers particular sciences, as of the jurisconsults, the mathematicians, the rhetoricians, the philosophers, there are set down some small memorials of the schools, authors and books; and so likewise some barren relations touching the invention of arts or usages.

But a just story of learning, containing the antiquities and originals of knowledges and their sects, their inventions, their traditions, their diverse administrations and managings, their flourishings, their oppositions, decays, depressions, oblivions, removes, with the causes and occasions of them, and all other events concerning learning, throughout the ages of the world, I may truly affirm to be wanting.

The use and end of which work, I do not so much design for curiosity, or satisfaction of those that are the lovers of learning, but chiefly for a more serious

and grave purpose, which is this in few words, that it will make learned men wise in the use and administration of learning. For it is not St. Augustine's nor St. Ambrose's works that will make so wise a divine, as ecclesiastical history thoroughly read and observed; and the same reason is of learning.

History of *Nature* is of three sorts; of nature in course, of nature erring or varying, and of nature altered or wrought; that is, history of creatures, history of marvels, and history of arts.

The first of these, no doubt, is extant, and that in good perfection; the two latter are handled so weakly and unprofitably, as I am moved to note them as deficient.

Historia naturæ errantis.

For I find no sufficient or competent collection of the works of nature, which have a digression and deflexion from the ordinary course of generations, productions, and motions, whether they be singularities of place and region, or the strange events of time and chance, or the effects of yet unknown properties, or the instances of exception to general kinds: it is true, I find a number of books of fabulous experiments and secrets, and frivolous impostures for pleasure and strangeness: but a substantial and severe collection of the heteroclites, or irregulars of nature, well examined and described, I find not, especially not with due rejection of fables, and popular errors: for as things now are, if an untruth in nature be once on foot, what by reason of the neglect of examination and countenance of antiquity, and what by reason of the use of the opinion in similitudes and ornaments of speech, it is never called down.

The use of this work, honoured with a precedent in Aristotle, is nothing less than to give contentment to the appetite of curious and vain wits, as the manner of mirabilaries is to do: but for two reasons, both of great weight: the one, to correct the partiality of axioms and opinions, which are commonly framed only upon common and familiar examples; the other, because from the wonders of nature is the

nearest intelligence and passage towards the wonders of art: for it is no more, but by following, and as it were hounding nature in her wanderings, to be able to lead her afterwards to the same place again.

Neither am I of opinion, in this history of marvels, that superstitious narrations of sorceries, witchcrafts, dreams, divinations, and the like, where there is an assurance and clear evidence of the fact, be altogether excluded. For it is not yet known in what cases, and how far effects attributed to superstition do participate of natural causes: and therefore howsoever the practice of such things is to be condemned, yet from the speculation and consideration of them light may be taken, not only for the discerning of the offences, but for the farther disclosing of nature. Neither ought a man to make scruple of entering into these things for inquisition of truth, as your majesty hath shewed in your own example: who with the two clear eyes of religion and natural philosophy have looked deeply and wisely into these shadows, and yet proved yourself to be of the nature of the sun, which passeth through pollutions, and itself remains as pure as before.

But this I hold fit, that these narrations, which have mixture with superstition, be sorted by themselves, and not to be mingled with the narrations, which are merely and sincerely natural.

But as for the narrations touching the prodigies and miracles of religions, they are either not true, or not natural; and therefore impertinent for the story of nature.

Historia mechanica.

For history of nature wrought, or mechanical, I find some collections made of agriculture, and likewise of manual arts, but commonly with a rejection of experiments familiar and vulgar.

For it is esteemed a kind of dishonour unto learning, to descend to inquiry or meditation upon matters mechanical, except they be such as may be thought secrets, rarities, and special subtilties; which humour of vain and supercilious arrogancy is justly derided in Plato; where he brings in Hippias, a

vaunting sophist, disputing with Socrates, a true and unfeigned inquisitor of truth; where the subject being touching beauty, Socrates, after his wandering manner of inductions, put first an example of a fair virgin, and then of a fair horse, and then of a fair pot well glazed, whereat Hippias was offended; and said, "More than for courtesy's sake, he did "think much to dispute with any that did alledge "such base and sordid instances;" whereunto Socrates answered, "You have reason, and it becomes "you well, being a man so trim in your vestments." *etc.* And so goeth on in irony.

But the truth is, they be not the highest instances that give the securest information; as may be well expressed in the tale so common of the philosopher, that while he gazed upwards to the stars fell into the water; for if he had looked down he might have seen the stars in the water, but looking aloft, he could not see the water in the stars. So it cometh often to pass, that mean and small things discover great, better than great can discover the small; and therefore Aristotle noteth well, "that the nature of "every thing is best seen in his smallest portions." And for that cause he inquireth the nature of a commonwealth, first in a family, and the simple conjugations of man and wife, parent and child, master and servant, which are in every cottage. Even so likewise the nature of this great city of the world, and the policy thereof, must be first sought in mean concordances and small portions. So we see how that secret of nature, of the turning of iron touched with the loadstone towards the north, was found out in needles of iron, not in bars of iron.

But if my judgment be of any weight, the use of History Mechanical is of all others the most radical and fundamental towards natural philosophy; such natural philosophy as shall not vanish in the fume of subtile, sublime, or delectable speculation, but such as shall be operative to the endowment and benefit of man's life: for it will not only minister and suggest for the present many ingenious practices in all trades,

by a connexion and transferring of the observations of one art to the use of another, when the experiences of several mysteries shall fall under the consideration of one man's mind; but farther, it will give a more true and real illumination concerning causes and axioms than is hitherto attained.

For like as a man's disposition is never well known till he be crossed, nor Proteus ever changed shapes till he was straitened and held fast; so the passages and variations of nature cannot appear so fully in the liberty of nature, as in the trials and vexations of art.

For *Civil History*, it is of three kinds, not unfitly to be compared with the three kinds of pictures or images: for of pictures or images, we see, some are unfinished, some are perfect, and some are defaced. So of histories we may find three kinds, Memorials, Perfect Histories, and Antiquities; for memorials are history unfinished, or the first or rough draughts of history; and antiquities are history defaced, or some remnants of history which have casually escaped the ship-wreck of time.

Memorials, or preparatory history, are of two sorts, whereof the one may be termed Commentaries, and the other Registers. Commentaries are they which set down a continuance of the naked events and actions, without the motives or designs, the counsels, the speeches, the pretexts, the occasions, and other passages of action: for this is the true nature of a Commentary, though Cæsar, in modesty mixed with greatness, did for his pleasure apply the name of a Commentary to the best history of the world. Registers are collections of public acts, as decrees of council, judicial proceedings, declarations and letters of state, orations and the like, without a perfect continuance or contexture of the thread of the narration.

Antiquities, or remnants of history, are, as was said, *tanquam tabula naufragii*, when industrious persons, by an exact and scrupulous diligence and ob-

servation, out of monuments, names, words, proverbs, traditions, private records and evidences, fragments of stories, passages of books that concern not story, and the like, do save and recover somewhat from the deluge of time.

In these kinds of imperfect histories I do assign no deficience, for they are *tanquam imperfecte mista*, and therefore any deficience in them is but their nature.

As for the corruptions and moths of history, which are Epitomes, the use of them deserveth to be banished, as all men of sound judgment have confessed, as those that have fretted and corroded the sound bodies of many excellent histories, and wrought them into base and unprofitable dregs.

History, which may be called *Just* and *Perfect History*, is of three kinds, according to the object which it propoundeth, or pretendeth to represent: for it either representeth a time, or a person, or an action. The first we call Chronicles, the second Lives, and the third Narrations or Relations.

Of these, although the first be the most complete and absolute kind of history, and hath most estimation and glory, yet the second excelleth it in profit and use, and the third in verity and sincerity. For history of times representeth the magnitude of actions, and the public faces and deportments of persons, and passeth over in silence the smaller passages and motions of men and matters.

But such being the workmanship of God, as he doth hang the greatest weight upon the smallest wires, *maxima è minimis suspendens*, it comes therefore to pass, that such histories do rather set forth the pomp of business than the true and inward resorts thereof. But Lives, if they be well written, propounding to themselves a person to represent, in whom actions both greater and smaller, public and private, have a commixture, must of a necessity contain a more true, native, and lively representation. So again narrations and relations of actions, as the War of Peloponnesus, the Expedition of Cyrus Minor, the Conspiracy of Catiline, cannot but be more purely and

exactly true, than histories of times, because they may choose an argument comprehensible within the notice and instructions of the writer: whereas he that undertaketh the story of a time, especially of any length, cannot but meet with many blanks and spaces, which he must be forced to fill up out of his own wit and conjecture.

For the *History of Times*, I mean of civil history, the providence of God hath made the distribution: for it hath pleased God to ordain and illustrate two exemplar states of the world of arms, learning, moral virtue, policy, and laws. The state of Græcia, and the state of Rome; the histories whereof occupying the middle part of time, have more ancient to them, histories which may by one common name be termed the Antiquities of the world; and after them, histories which may be likewise called by the name of Modern History.

Now to speak of the deficiencies. As to the heathen antiquities of the world, it is in vain to note them for deficient: deficient they are no doubt, consisting mostly of fables and fragments, but the deficience cannot be holpen; for antiquity is like fame, *caput inter nubila condit*, her head is muffled from our sight. For the history of the exemplar states, it is extant in good perfection. Not but I could wish there were a perfect course of history for Græcia from Theseus to Philopœmen, what time the affairs of Græcia were drowned and extinguished in the affairs of Rome; and for Rome from Romulus to Justinianus, who may be truly said to be *ultimus Romanorum*. In which sequences of story the text of Thucydides and Xenophon in the one, and the text of Livius, Polybius, Salustius, Cæsar, Appianus, Tacitus, Herodianus, in the other, to be kept intire without any diminution at all, and only to be supplied and continued. But this is matter of magnificence, rather to be commended than required: and we speak now of parts of learning supplemental, and not of supererogation.

But for modern Histories, whereof there are some few very worthy, but the greater part beneath me-

diocrity, leaving the care of foreign stories to foreign states, because I will not be *curiosus in aliena republica*, I cannot fail to represent to your majesty the unworthiness of the history of England in the main continuance thereof, and the partiality and obliquity of that of Scotland, in the latest and largest author that I have seen; supposing that it would be honour for your majesty, and a work very memorable, if this island of Great Britain, as it is now joined in monarchy for the ages to come, so were joined in one history for the times passed, after the manner of the sacred history, which draweth down the story of the ten tribes, and of the two tribes, as twins, together. And if it shall seem that the greatness of this work may make it less exactly performed, there is an excellent period of a smaller compass of time, as to the story of England; that is to say, from the uniting of the roses to the uniting of the kingdoms: a portion of time, wherein, to my understanding, there hath been the rarest varieties, that, in like number of successions of any hereditary monarchy hath been known: for it beginneth with the mixed adeption of a crown by arms and title; an entry by battle, an establishment by marriage; and therefore times answerable, like waters after a tempest, full of working and swelling, though without extremity of storm; but well passed through by the wisdom of the pilot, being one of the most sufficient kings of all the number. Then followeth the reign of a king, whose actions, howsoever conducted, had much intermixture with the affairs of Europe, balancing and inclining them variably; in whose time also began that great alteration in the state ecclesiastical, an action which seldom cometh upon the stage. Then the reign of a minor: then an offer of an usurpation, though it was but as *febris ephemera:* then the reign of a queen matched with a foreigner: then of a queen that lived solitary and unmarried, and yet her government so masculine, as it had greater impression and operation upon the states abroad than it any ways received from thence. And now last, this most happy and glorious event, that this

island of Britain, divided from all the world, should be united in itself: and that oracle of rest, given to Æneas, *Antiquam exquirite matrem*, should now be performed and fulfilled upon the nations of England and Scotland, being now reunited in the ancient mother name of Britain, as a full period of all instability and peregrinations: so that as it cometh to pass in massive bodies, that they have certain trepidations and waverings before they fix and settle; so it seemeth that by the providence of God this monarchy, before it was to settle in your majesty and your generations, in which, I hope, it is now established for ever, it had these prelusive changes and varieties.

For *Lives*; I do find strange that these times have so little esteemed the virtues of the times, as that the writing of lives should be no more frequent. For although there be not many sovereign princes or absolute commanders, and that states are most collected into monarchies, yet there are many worthy personages that deserve better than dispersed report or barren eulogies. For herein the invention of one of the late poets is proper, and doth well inrich the ancient fiction: for he feigneth, that at the end of the thread or web of every man's life there was a little medal containing the person's name, and that Time waited upon the shears; and as soon as the thread was cut, caught the medals, and carried them to the river of Lethe; and about the bank there were many birds flying up and down, that would get the medals and carry them in their beak a little while, and then let them fall into the river: only there were a few swans, which if they got a name, would carry it to a temple where it was consecrated.

And though many men, more mortal in their affections than in their bodies, do esteem desire of name and memory but as a vanity and ventosity,

Animi nil magnæ laudis egentes;

which opinion cometh from the root, *non prius laudes contempsimus, quam laudanda facere desivimus:* yet that will not alter Solomon's judgment, *Memoria justi cum laudibus, at impiorum nomen putrescet:* the one

flourisheth, the other either consumeth to present oblivion, or turneth to an ill odour.

And therefore in that stile or addition, which is and hath been long well received and brought in use, *felicis memoriæ, piæ memoriæ, bonæ memoriæ*, we do acknowledge that which Cicero saith, borrowing it from Demosthenes, that *bona fama propria possessio defuncturum*; which possession I cannot but note, that in our times it lieth much waste, and that therein there is a deficience.

For *Narrations* and *Relations* of particular actions, there were also to be wished a greater diligence therein; for there is no great action but hath some good pen which attends it.

And because it is an ability not common to write a good history, as may well appear by the small number of them; yet if particularity of actions memorable were but tolerably reported as they pass, the compiling of a complete history of times might be the better expected, when a writer should arise that were fit for it; for the collection of such relations might be as a nursery garden, whereby to plant a fair and stately garden, when time should serve.

There is yet another partition of history which Cornelius Tacitus maketh, which is not to be forgotten, especially with that application which he accoupleth it withal, *Annals* and *Journals*: appropriating to the former, matters of state; and to the latter, acts and accidents of a meaner nature. For giving but a touch of certain magnificent buildings, he addeth, *Cum ex dignitate populi Romani repertum sit, res illustres annalibus, talia diurnis urbis actis mandare.* So as there is a kind of contemplative heraldry, as well as civil. And as nothing doth derogate from the dignity of a state more than confusion of degrees: so it doth not a little embase the authority of an history, to intermingle matters of triumph, or matters of ceremony, or matters of novelty, with matters of state. But the use of a journal hath not only been in the history of time, but likewise in the history of persons, and chiefly of actions; for princes in ancient time

had, upon point of honor and policy both, journals kept of what passed day by day: for we see the Chronicle which was read before Ahasuerus, when he could not take rest, contained matter of affairs indeed, but such as had passed in his own time, and very lately before: but the journal of Alexander's house expressed every small particularity, even concerning his person and court; and it is yet an use well received in enterprises memorable, as expeditions of war, navigations, and the like, to keep diaries of that which passeth continually.

I cannot likewise be ignorant of a form of writing, which some grave and wise men have used, containing a scattered history of those actions which they have thought worthy of memory, with politic discourse and observation thereupon; not incorporated into the history, but separately, and as the more principal in their intention; which kind of ruminated history I think more fit to place amongst books of policy, whereof we shall hereafter speak, than amongst books of history: for it is the true office of history to represent the events themselves together with the counsels, and to leave the observations and conclusions thereupon to the liberty and faculty of every man's judgment; but mixtures are things irregular, whereof no man can define.

So also is there another kind of history manifoldly mixed, and that is History of Cosmography, being compounded of natural history, in respect of the regions themselves; of history civil, in respect of the habitations, regimens, and manners of the people; and the mathematics, in respect of the climates and configurations towards the heavens; which part of learning of all others, in this latter time, hath obtained most proficience. For it may be truly affirmed to the honour of these times, and in a virtuous emulation with antiquity, that this great building of the world had never thorough lights made in it, till the age of us and our fathers; for although they had knowledge of the antipodes,

Nosque ubi primus equis oriens afflavit anhelis,
Illic sera rubens accendit lumina Vesper:

yet that might be by demonstration, and not in fact; and if by travel, it requireth the voyage but of half the globe. But to circle the earth, as the heavenly bodies do, was not done or enterprised till these latter times: and therefore these times may justly bear in their word, not only *plus ultra* in precedence of the ancient *non ultra*, and *imitabile fulmen*, in precedence of the ancient *non imitabile fulmen*,

Demens qui nimbos et non imitabile fulmen, etc.

but likewise *imitabile cælum:* in respect of the many memorable voyages, after the manner of heaven, about the globe of the earth.

And this proficience in navigation and discoveries may plant also an expectation of the farther proficience and augmentation of all sciences; because, it may seem, they are ordained by God to be coevals, that is, to meet one age. For so the prophet Daniel, speaking of the latter times, foretelleth; *Plurimi pertransibunt, et multiplex erit scientia;* as if the openness and thorough passage of the world, and the increase of knowledge, were appointed to be in the same ages, as we see it is already performed in great part; the learning of these latter times not much giving place to the former two periods or returns of learning, the one of the Grecians, the other of the Romans.

History ecclesiastical receiveth the same divisions with history civil; but farther, in the propriety thereof, may be divided into the history of the church, by a general name; History of prophecy; and History of providence.

The first describeth the times of the militant church, whether it be fluctuant, as the ark of Noah; or moveable, as the ark in the wilderness; or at rest, as the ark in the temple; that is, the state of the church in persecution, in remove, and in peace. This part I ought in no sort to note as deficient, only I would that the virtue and sincerity of it were according to the mass and quantity. But I am not now in hand with censures, but with omissions.

Historia Prophetica.

The second, which is history of prophecy, consisteth of two relatives, the prophecy, and the accomplishment; and therefore the nature of such a work ought to be, that every prophecy of the scripture be sorted with the event fulfilling the same, throughout the ages of the world; both for the better confirmation of faith, and for the better illumination of the church touching those parts of prophecies which are yet unfulfilled: allowing nevertheless that latitude which is agreeable and familiar unto divine prophecies, being of the nature of their author, with whom a thousand years are but as one day, and therefore are not fulfilled punctually at once, but have springing and germinant accomplishment throughout many ages; though the height or fulness of them may refer to some one age.

This is a work which I find deficient, but is to be done with wisdom, sobriety, and reverence, or not at all.

The third, which is history of providence, containeth that excellent correspondence which is between God's revealed will and his secret will: which though it be so obscure, as for the most part it is not legible to the natural man; no, nor many times to those who behold it from the tabernacle; yet at some times it pleaseth God, for our better establishment, and the confuting of those which are as without God in the world, to write it in such text and capital letters, that, as the prophet saith, *he that runneth by may read it;* that is, mere sensual persons, which hasten by God's judgments and never bend or fix their cogitations upon them, are nevertheless in their passage and race urged to discern it. Such are the notable events and examples of God's judgments, chastisements, deliverances, and blessings: and this is a work which hath passed through the labours of many, and therefore I cannot present as omitted.

There are also other parts of learning which are Appendices to history: for all the exterior proceedings of man consist of words and deeds; whereof history doth properly receive and retain in memory

the deeds; and if words, yet but as inducements and passages to deeds: so are there other books and writings, which are appropriated to the custody and receipt of words only, which likewise are of three sorts; Orations, Letters, and brief Speeches or Sayings.

Orations are pleadings, speeches of counsel, laudatives, invectives, apologies, reprehensions; orations of formality or ceremony, and the like.

Letters are according to all the variety of occasions, advertisements, advices, directions, propositions, petitions, commendatory, expostulatory, satisfactory; of compliment, of pleasure, of discourse, and all other passages of action. And such as are written from wise men, are of all the words of man, in my judgment, the best; for they are more natural than orations and public speeches, and more advised than conferences or present speeches. So again letters of affairs from such as manage them, or are privy to them, are of all others the best instructions for history, and to a diligent reader the best histories in themselves.

For Apophthegms, it is a great loss of that book of Cæsar's; for as his history, and those few letters of his which we have, and those apophthegms which were of his own, excel all mens else, so I suppose would his collection of apophthegms have done; for as for those which are collected by others, either I have no taste in such matters, or else their choice hath not been happy. But upon these three kinds of writings I do not insist, because I have no deficiencies to propound concerning them.

Thus much therefore concerning history, which is that part of learning which answereth to one of the cells, domiciles, or offices of the mind of man, which is that of the memory.

POESY is a part of learning in measure of words for the most part restrained, but in all other points extremely licensed, and doth truly refer to the imagination; which, being not tied to the laws of mat-

ter, may at pleasure join that which nature hath severed, and sever that which nature hath joined, and so make unlawful matches and divorces of things; *Pictoribus atque poetis, etc.* It is taken in two senses, in respect of words, or matter; in the first sense it is but a character of stile, and belongeth to arts of speech, and is not pertinent for the present: in the latter, it is, as hath been said, one of the principal portions of learning, and is nothing else but feigned history, which may be stiled as well in prose as in verse.

The use of this feigned history hath been to give some shadow of satisfaction to the mind of man in those points wherein the nature of things doth deny it, the world being in proportion inferior to the soul, by reason whereof there is, agreeable to the spirit of man, a more ample greatness, a more exact goodness, and a more absolute variety, than can be found in the nature of things. Therefore, because the acts or events of true history have not that magnitude which satisfieth the mind of man, poesy feigneth acts and events greater and more heroical: because true history propoundeth the successes and issues of actions not so agreeable to the merits of virtue and vice, therefore poesy feigns them more just in retribution, and more according to revealed providence: because true history representeth actions and events more ordinary, and less interchanged; therefore poesy endueth them with more rareness, and more unexpected and alternative variations: so as it appeareth that poesy serveth and conferreth to magnanimity, morality, and to delectation. And therefore it was ever though to have some participation of divineness, because it doth raise and erect the mind, by submitting the shews of things to the desires of the mind; whereas reason doth buckle and bow the mind unto the nature of things.

And we see, that by these insinuations and congruities with man's nature and pleasure, joined also with the agreement and consort it hath with music, it hath had access and estimation in rude times and

barbarous regions, where other learning stood excluded.

The division of poesy, which is aptest in the propriety thereof, besides those divisions which are common unto it with history; as feigned chronicles, feigned lives, and the appendices of history, as feigned epistles, feigned orations, and the rest, is into Poesy Narrative, Representative, and Allusive.

The Narrative is a mere imitation of history, with the excesses before remembered, choosing for subject commonly wars and love; rarely state, and sometimes pleasure or mirth.

Representative is as a visible history, and is an image of actions as if they were present, as history is of actions in nature as they are, that is past.

Allusive or parabolical, is a narration applied only to express some special purpose or conceit: which latter kind of parabolical wisdom was much more in use in the ancient times, as by the fables of Æsop, and the brief sentences of the Seven, and the use of hieroglyphics, may appear. And the cause was, for that it was then of necessity to express any point of reason, which was more sharp or subtile than the vulgar, in that manner, because men in those times wanted both variety of examples and subtilty of conceit: and as hieroglyphics were before letters, so parables were before arguments. And nevertheless now, and at all times, they do retain much life and vigour, because reason cannot be so sensible, nor examples so fit.

But there remaineth yet another use of poesy parabolical, opposite to that which we last mentioned: for that tendeth to demonstrate and illustrate that which is taught or delivered, and this other to retire and obscure it: that is, when the secrets and mysteries of religion, policy, or philosophy, are involved in fables and parables.

Of this in divine poesy, we see, the use is authorised. In heathen poesy, we see, the exposition of fables doth fall out sometimes with great felicity, as in the fable that the giants being overthrown in their

war against the gods, the Earth their mother, in revenge thereof, brought forth Fame:

Illam terra parens ira irritata deorum,
Extremam, ut perhibent, Cœo Enceladoque sororem
Progenuit.

Expounded, that when Princes and monarchies have suppressed actual and open rebels, then the malignity of people, which is the mother of rebellion, doth bring forth libels and slanders, and taxations of the states, which is of the same kind with rebellion, but more feminine. So in the fable, that the rest of the gods having conspired to bind Jupiter, Pallas called Briareus with his hundred hands to his aid: expounded, that monarchies need not fear any curbing of their absoluteness by mighty subjects, as long as by wisdom they keep the hearts of the people, who will be sure to come in on their side. So in the fable, that Achilles was brought up under Chiron the Centaur, who was part a man and part a beast; expounded ingeniously, but corruptly by Machiavel, that it belongeth to the education and discipline of princes to know as well how to play the part of the lion in violence, and the fox in guile, as of the man in virtue and justice.

Nevertheless in many the like encounters, I do rather think that the fable was first, and the exposition devised, than that the moral was first, and thereupon the fable framed. For I find it was an ancient vanity in Chrysippus that troubled himself with great contention to fasten the assertions of the Stoics upon fictions of the ancient poets; but yet that all the fables and fictions of the poets were but pleasure and not figure, I interpose no opinion.

Surely of those poets which are now extant, even Homer himself, notwithstanding he was made a kind of Scripture by the latter schools of the Grecians, yet I should without any difficulty pronounce, that his fables had no such inwardness in his own meaning; but what they might have upon a more original tradition, is not easy to affirm, for he was not the inventor of many of them.

In this third part of learning, which is poesy, I can report no deficience. For being as a plant that cometh of the lust of the earth, without a formal seed, it hath sprung up, and spread abroad more than any other kind: but to ascribe unto it that which is due, for the expression of affections, passions, corruptions, and customs, we are beholden to poets more than to the philosophers works; and for wit and eloquence, not much less than to orators harangues. But it is not good to stay too long in the theatre. Let us now pass to the judicial place or palace of the mind, which we are to approach and view with more reverence and attention.

THE knowledge of man is as the waters, some descending from above, and some springing from beneath; the one informed by the light of nature, the other inspired by divine revelation.

The light of nature consisteth in the notions of the mind, and the reports of the senses; for as for knowledge which man receiveth by teaching, it is cumulative and not original, as in a water, that, besides his own spring-head, is fed with other springs and streams. So then, according to these two differing illuminations or originals, knowledge is first of all divided into Divinity and Philosophy.

In Philosophy, the contemplations of man do neither penetrate unto God, or are circumferred to nature, or are reflected or reverted upon himself. Out of which several inquiries there do arise three knowledges, Divine philosophy, Natural philosophy, and Human philosophy or humanity. For all things are marked and stamped with this triple character, of the power of God, the difference of nature, and the use of man. But because the distributions and partitions of knowledge are not like several lines that meet in one angle, and so touch but in a point; but are like branches of a tree, that meet in a stem, which hath a dimension and quantity of intireness and continuance, before it come to discontinue and break itself into arms and boughs; therefore it is

good, before we enter into the former distribution, to erect and constitute one universal science, by the name of *Philosophia prima*, primitive or summary philosophy, as the main and common way, before we come where the ways part and divide themselves; which science, whether I should report as deficient or no, I stand doubtful.

For I find a certain rhapsody of natural theology, and of divers parts of logic; and of that other part of natural philosophy, which concerneth the principles; and of that other part of natural philosophy which concerneth the soul or spirit; all these strangely commixed and confused; but being examined, it seemeth to me rather a depredation of other sciences, advanced and exalted unto some height of terms, than any thing solid or substantial of itself.

Nevertheless I cannot be ignorant of the distinction which is current, that the same things are handled but in several respects. As for example, that logic considereth of many things as they are in notion; and this philosophy, as they are in nature; the one in appearance, the other in existence: but I find this difference better made than pursued. For if they had considered quantity, similitude, diversity, and the rest of those external characters of things, as philosophers, and in nature; their inquiries must of force have been of a far other kind than they are.

For doth any of them, in handling quantity, speak of the force of union, how, and how far it multiplieth virtue? Doth any give the reason, why some things in nature are so common and in so great mass, and others so rare, and in so small quantity? Doth any, in handling similitude and diversity, assign the cause why iron should not move to iron, which is more like, but move to the loadstone which is less like? Why, in all diversities of things, there should be certain participles in nature, which are almost ambiguous, to which kind they should be referred? But there is a mere and deep silence touching the nature and operation of those common adjuncts of things, as in nature; and only a resuming and repeating of the force and use of them in speech or argument.

Therefore because in a writing of this nature I avoid all subtilty, my meaning touching this original or universal philosophy is thus, in a plain and gross description by negative; "That it be a receptacle "for all such profitable observations and axioms, as "fall not within the compass of any of the special "parts of philosophy or sciences, but are more "common and of a higher stage."

Now that there are many of that kind, need not to be doubted. For example; is not the rule *Si inæqualibus æqualia addas, omnia erunt inæqualia,* an axiom as well of justice as of the mathematics? And is there not a true coincidence between commutative and distributive justice, and arithmetical and geometrical proportion? Is not that other rule, *Quæ in eodem tertio conveniunt, et inter se conveniunt,* a rule taken from the mathematics, but so potent in logic, as all syllogisms are built upon it? Is not the observation, *Omnia mutantur, nil interit,* a contemplation in philosophy thus, that the *quantum* of nature is eternal? in natural theology thus; that it requireth the same omnipotence to make something nothing, which at the first made nothing something; according to the scripture, *Didici quod omnia opera, quæ fecit Deus, perseverent in perpetuum; non possumus eis quicquam addere, nec auferre.*

Is not the ground, which Machiavel wisely and largely discourseth concerning governments, that the way to establish and preserve them, is to reduce them *ad principia;* a rule in religion and nature, as well as in civil administation? Was not the Persian magic a reduction or correspondence of the principles and architectures of nature, to the rules and policy of governments? Is not the precept of a musician, to fall from a discord or harsh accord upon a concord or sweet accord, alike true in affection? Is not the trope of music, to avoid or slide from the close or cadence, common with the trope of rhetoric, of deceiving expectation? Is not the delight of the quavering upon a stop in music, the same with the playing of light upon the water?

Splendet tremulo sub lumine pontus.

Are not the organs of the senses of one kind with the organs of reflection, the eye with a glass, the ear with a cave or strait determined and bounded? Neither are these only similitudes, as men of narrow observation may conceive them to be, but the same footsteps of nature, treading or printing upon several subjects or matters.

Philosophia prima, sive de fontibus scientiarum.

This science therefore, as I understand it, I may justly report as deficient; for I see sometimes the profounder sort of wits, in handling some particular argument, will now and then draw a bucket of water out of this well for their present use; but the spring-head thereof seemeth to me not to have been visited; being of so excellent use, both for the disclosing of nature, and the abridgement of art.

This science being therefore first placed as a common parent, like unto Berecynthia, which had so much heavenly issue, *Omnes cælicolas, omnes supera alta tenentes,* we may return to the former distribution of the three philosophies, divine, natural, and human.

And as concerning divine philosophy, or Natural Theology, it is that knowledge or rudiment of knowledge concerning God, which may be obtained by the contemplation of his creatures; which knowledge may be truly termed divine, in respect of the object, and natural in respect of the light.

The bounds of this knowledge are, that it sufficeth to convince atheism, but not to inform religion: and therefore there was never miracle wrought by God to convert an atheist, because the light of nature might have led him to confess a God: but miracles have been wrought to convert idolaters and the superstitious, because no light of nature extendeth to declare the will and true worship of God.

For as all works do shew forth the power and skill of the workman, and not his image, so it is of the works of God, which do shew the omnipotency and wisdom of the maker, but not his image: and therefore therein the heathen opinion differeth from

the sacred truth; for they supposed the world to be the image of God, and man to be an extract or compendious image of the world; but the Scriptures never vouchsafe to attribute to the world that honor, as to be the image of God, but only the work of his hands; neither do they speak of any other image of God, but man: wherefore by the contemplation of nature, to induce and inforce the acknowledgment of God, and to demonstrate his power, providence and goodness, is an excellent argument, and hath been excellently handled by divers.

But on the other side, out of the contemplation of nature or ground of human knowledges, to induce any verity or persuasion concerning the points of faith, is in my judgment not safe: *Da fidei, quæ fidei sunt.* For the heathens themselves conclude as much in that excellent and divine fable of the golden chain; "That men and gods were not able to "draw Jupiter down to the earth; but contrariwise, "Jupiter was able to draw them up to heaven."

So as we ought not to attempt to draw down or submit the mysteries of God to our reason; but contrariwise, to raise and advance our reason to the divine truth. So as in this part of knowledge, touching divine philosophy, I am so far from noting any deficience, as I rather note an excess; whereunto I have digressed, because of the extreme prejudice which both religion and philosophy have received, and may receive, by being commixed together; as that which undoubtedly will make an heretical religion, and an imaginary and fabulous philosophy.

Otherwise it is of the nature of angels and spirits, which is an appendix of theology, both divine and natural, and is neither inscrutable nor interdicted; for although the Scripture saith, *Let no man deceive you in sublime discourse touching the worship of angels, pressing into that he knoweth not*, &c. yet, notwithstanding, if you observe well that precept, it may appear thereby that there be two things only forbidden, adoration of them, and opinion fantastical of them, either to extol them farther than appertaineth

to the degree of a creature, or to extol a man's knowledge of them farther than he hath ground. But the sober and grounded inquiry, which may arise out of the passages of holy Scriptures, or out of the gradations of nature, is not restrained. So of degenerate and revolted spirits, the conversing with them, or the employment of them is prohibited, much more any veneration towards them. But the contemplation or science of their nature, their power, their illusions, either by Scripture or reason, is a part of spiritual wisdom. For so the apostle saith, *We are not ignorant of his stratagems.* And it is no more unlawful to inquire the nature of evil spirits, than to inquire the force of poisons in nature, or the nature of sin and vice in morality. But this part, touching angels and spirits, I cannot note as deficient, for many have occupied themselves in it: I may rather challenge it, in many of the writers thereof, as fabulous and fantastical.

Leaving therefore divine philosophy or natural theology, not divinity, or inspired theology, which we reserve for the last of all, as the haven and sabbath of all man's contemplations, we will now proceed to Natural Philosophy.

If then it be true that Democritus said, "That the "truth of nature lieth hid in certain deep mines and "caves:" and if it be true likewise that the alchemists do so much inculcate, that Vulcan is a second nature, and imitateth that dexterously and compendiously, which nature worketh by ambages and length of time; it were good to divide natural philosophy into the mine and the furnace, and to make two professions or occupations of natual philosophers, some to be pioneers, and some smiths; some to dig, and some to refine and hammer: and surely I do best allow of a division of that kind, though in more familiar and scholastical terms: namely, that these be the two parts of natural philosophy, the inquisition of causes, and the production of effects; speculative, and operative; natual science, and natural prudence.

For as in civil matters there is a wisdom of discourse, and a wisdom of direction; so is it in natural. And here I will make a request, that for the latter, or at least for a part thereof, I may revive and redintegrate the misapplied and abused name of natural magic, which, in the true sense, is but natural wisdom, or natural prudence; taken according to the ancient acceptation, purged from vanity and superstition.

Now although it be true, and I know it well, that there is an intercourse between causes and effects, so as both these knowledges, speculative and operative, have a great connection between themselves; yet because all true and fruitful natural philosophy hath a double scale or ladder, ascendent and descendent; ascending from experiments, to the invention of causes; and descending from causes, to the invention of new experiments; therefore I judge it most requisite that these two parts be severally considered and handled.

Natural science, or theory, is divided into Physic and Metaphysic; wherein I desire it may be conceived, that I use the word metaphysic in a differing sense from that that is received: and, in like manner, I doubt not but it will easily appear to men of judgment, that in this and other particulars, wheresoever my conception and notion may differ from the ancient, yet I am studious to keep the ancient terms.

For hoping well to deliver myself from mistaking, by the order and perspicuous expressing of that I do propound; I am otherwise zealous and affectionate to recede as little from antiquity, either in terms or opinions, as may stand with truth, and the proficience of knowledge.

And herein I cannot a little marvel at the philosopher Aristotle, that did proceed in such a spirit of difference and contradiction towards all antiquity, undertaking not only to frame new words of science at pleasure, but to confound and extinguish all ancient wisdom: insomuch as he never nameth or mentioneth an ancient author or opinion, but to confute and

reprove; wherein for glory, and drawing followers and disciples, he took the right course.

For certainly there cometh to pass, and hath place in human truth, that which was noted and pronounced in the highest truth; *Veni in nomine Patris, nec recipitis me; si quis venerit in nomine suo, eum recipietis.* But in this divine aphorism, considering to whom it was applied, namely to Antichrist, the highest deceiver, we may discern well, that the coming in a man's own name, without regard of antiquity or paternity, is no good sign of truth, although it be joined with the fortune and success of an *Eum recipietis.*

But for this excellent person, Aristotle, I will think of him, that he learned that humour of his scholar, with whom, it seemeth, he did emulate, the one to conquer all opinions, as the other to conquer all nations: wherein nevertheless, it may be, he may at some mens hands, that are of a bitter disposition, get a like title as his scholar did.

Felix terrarum prædo, non utile mundo
Editus exemplum, etc.

So

Felix doctrinæ prædo.

But to me, on the other side, that do desire as much as lieth in my pen to ground a sociable intercourse between antiquity and proficience, it seemeth best to keep way with antiquity *usque ad aras;* and therefore to retain the ancient terms, though I sometimes alter the uses and definitions; according to the moderate proceeding in civil government, where, although there be some alteration, yet that holdeth which Tacitus wisely noteth, *eadem magistratuum vocabula.*

To return therefore to the use and acceptation of the word metaphysic, as I do now understand the word; it appeareth, by that which hath been already said, that I intend *philosophia prima,* summary philosophy, and metaphysic, which heretofore have been confounded as one, to be two distinct things. For, the one I have made as a parent, or common ancestor, to all knowledge; and the other I have now

brought in, as a branch, or descendent of natural science. It appeareth likewise that I have assigned to summary philosophy the common principles and axioms which are promiscuous and indifferent to several sciences: I have assigned unto it likewise the inquiry touching the operation of the relative and adventitious characters of essences, as quantity, similitude, diversity, possibility, and the rest; with this distinction and provision; that they be handled as they have efficacy in nature, and not logically. It appeareth likewise, that natural theology, which heretofore hath been handled confusedly with metaphysic, I have inclosed and bounded by itself.

It is therefore now a question, what is left remaining for metaphysic; wherein I may without prejudice preserve thus much of the conceit of antiquity, that physic should contemplate that which is inherent in matter, and therefore transitory; and metaphysic, that which is abstracted and fixed.

And again, that physic should handle that which supposeth in nature only a being and moving; and metaphysic should handle that which supposeth farther in nature, a reason, understanding, and platform. But the difference perspicuously expressed, is most familiar and sensible.

For as we divided natural philosophy in general into the inquiry of causes, and productions of effects; so that part which concerneth the inquiry of causes, we do subdivide according to the received and sound division of causes; the one part, which is physic, inquireth and handleth the material and efficient causes; and the other, which is metaphysic, handleth the formal and final causes.

Physic, taking it according to the derivation, and not according to our idiom for medicine, is situate in a middle term, or distance, between natural history and metaphysic. For natural history describeth the variety of things, physic the causes, but variable or respective causes; and metaphysic, the fixed and constant causes.

Limus ut hic durescit, et hæc ut cera liquescit,
Uno eodemque igne.

Fire is the cause of induration but respective to clay: fire is the cause of colliquation but respective to wax. But fire is no constant cause either of induration or colliquation: so then the physical causes are but the efficient and the matter.

Physic hath three parts, whereof two respect nature united or collected, the third contemplateth nature diffused or distributed.

Nature is collected either into one intire total, or else into the same principles or seeds. So as the first doctrine is touching the contexture or configuration of things, as *de mundo, de universitate rerum.*

The second is the doctrine concerning the principles or originals of things.

The third is the doctrine concerning all variety and particularity of things; whether it be of the differing substances, or their differing qualities and natures; whereof there needeth no enumeration, this part being but as a gloss, or paraphrase, that attendeth upon the text of natural history.

Of these three I cannot report any as deficient. In what truth or perfection they are handled, I make not now any judgment: but they are parts of knowledge not deserted by the labour of man.

For Metaphysic, we have assigned unto it the inquiry of formal and final causes; which assignation, as to the former of them, may seem to be nugatory and void, because of the received and inveterate opinion, that the inquisition of man is not competent to find out essential forms or true differences: of which opinion we will take this hold, that the invention of forms is of all other parts of knowledge the worthiest to be sought, if it be possible to be found.

As for the possibility, they are ill discoverers that think there is no land, when they can see nothing but sea.

But it is manifest, that Plato, in his opinion of ideas, as one that had a wit of elevation situate as upon a cliff, did descry, "That forms were the true

" object of knowledge;" but lost the real fruit of his opinion, by considering of forms as absolutely abstracted from matter, and not confined and determined by matter; and so turning his opinion upon theology, wherewith all his natural philosophy is infected.

But if any man shall keep a continual watchful and severe eye upon action, operation, and the use of knowledge, he may advise and take notice what are the forms, the disclosures whereof are fruitful and important to the state of man. For as to the forms of substances, man only except, of whom it is said, *Formavit hominem de limo terræ, et spiravit in faciem ejus spiraculum vitæ*, and not as of all other creatures, *Producant aquæ, producat terra*, the forms of substances: I say, as they are now by compounding and transplanting multiplied, are so perplexed, as they are not to be inquired; no more than it were either possible or to purpose, to seek in gross the forms of those sounds which make words, which by composition and transposition of letters are infinite.

But, on the other side, to inquire the form of those sounds or voices which make simple letters, is easily comprehensible; and being known, induceth and manifesteth the forms of all words, which consist and are compounded of them. In the same manner to inquire the form of a lion, of an oak, of gold; nay, of water, of air, is a vain pursuit: but to inquire the forms of sense, of voluntary motion, of vegetation, of colours, of gravity and levity, of density, of tenuity, of heat, of cold, and all other natures and qualities, which, like an alphabet, are not many, and of which the essences, upheld by matter, of all creatures do consist: to inquire, I say, the true forms of these, is that part of metaphysic which we now define of.

Not but that physic doth make inquiry, and take consideration of the same natures: but how? Only as to the material and efficient causes of them, and not as to the forms. For example; if the cause of whiteness in snow or froth be inquired, and it be

rendered thus; that the subtile intermixture of air and water is the cause, it is well rendered; but nevertheless, is this the form of whiteness? No; but it is the efficient, which is ever but *vehiculum formæ*.

Metaphysica, sive de formis et finibus rerum.

This part of metaphysic I do not find laboured and performed, whereat I marvel not: because I hold it not possible to be invented by that course of invention which hath been used, in regard that men, which is the root of all error, have made too untimely a departure, and too remote a recess from particulars.

But the use of this part of metaphysic which I report as deficient, is of the rest the most excellent in two respects: the one, because it is the duty and virtue of all knowledge to abridge the infinity of individual experience, as much as the conception of truth will permit, and to remedy the complaint of *vita brevis, ars longa;* which is performed by uniting the notions and conceptions of sciences: for knowledges are as pyramids, whereof history is the basis. So of natural philosophy, the basis is natural history; the stage next the basis is physic; the stage next the vertical point is metaphysic. As for the vertical point, *Opus, quod operatur Deus à principio usque ad finem*, the summary law of nature, we know not whether man's inquiry can attain unto it. But these three be the true stages of knowledge, and are to them that are depraved no better than the giants hills.

Ter sunt conati imponere Pelio Ossam
Scilicet, atque Ossæ frondosum involvere Olympum.

But to those which refer all things to the glory of God, they are as the three acclamations, *Sancte, sancte, sancte*; holy in the description, or dilatation of his works; holy in the connection or concatenation of them; and holy in the union of them in a perpetual and uniform law.

And therefore the speculation was excellent in Parmenides and Plato, although but a speculation in them, that all things by scale did ascend to unity. So then always that knowledge is worthiest, which is charged with least multiplicity; which appeareth to be metaphysic, as that which considereth the simple forms or differences of things, which are few

in number, and the degrees and co-ordinations whereof make all this variety.

The second respect which valueth and commendeth this part of metaphysic, is, that it doth enfranchise the power of man unto the greatest liberty and possibility of works and effects. For physic carrieth men in narrow and restrained ways, subject to many accidents of impediments, imitating the ordinary flexuous courses of nature; but *latæ undique sunt sapientibus viæ:* to sapience, which was anciently defined to be *rerum divinarum et humanarum scientia*, there is ever choice of means: for physical causes give light to new invention *in simili materia*. But whosoever knoweth any form, knoweth the utmost possibility of super-inducing that nature upon any variety of matter, and so is less restrained in operation either to the basis of the matter, or the condition of the efficient: which kind of knowledge Solomon likewise, though in a more divine sense, elegantly describeth; *Non arctabunter gressus tui, et currens non habebis offendiculum*. They of sapience are not much liable either to particularity or chance.

The second part of metaphysic is the inquiry of final causes, which I am moved to report, not as omitted, but as misplaced; and yet if it were but a fault in order, I would not speak of it: for order is matter of illustration, but pertaineth not to the substance of sciences. But this misplacing hath caused a deficience, or at least a great improficience in the sciences themselves. For the handling of final causes, mixed with the rest in physical inquiries, hath intercepted the severe and diligent inquiry of all real and physical causes, and given men the occasion to stay upon these satisfactory and specious causes, to the great arrest and prejudice of farther discovery.

For this I find done not only by Plato, who ever anchoreth upon that shore, but by Aristotle, Galen, and others, which do usually likewise fall upon these flats of discoursing causes. For to say that the hairs of the eyelids are for a quickset and fence about the sight; or, that the firmness of the skins and

hides of living creatures is to defend them from the extremities of heat or cold; or that the bones are for the columns or beams, whereupon the frame of the bodies of living creatures is built; or, that the leaves of the trees are for protecting of the fruit; or, that the clouds are for watering of the earth; or, that the solidness of the earth is for the station and mansion of living creatures, and the like, is well inquired and collected in metaphysic; but in physic they are impertinent. Nay, they are indeed but remoras and hinderances to stay and slug the ship from farther sailing, and have brought this to pass, that the search of the physical causes hath been neglected, and passed in silence.

And therefore the natural philosophy of Democritus, and some others, who did not suppose a mind or reason in the frame of things, but attributed the form thereof, able to maintain itself, to infinite essays or proofs of nature, which they term fortune; seemeth to me, as far as I can judge by the recital and fragments which remain unto us, in particularities of physical causes, more real and better inquired than that of Aristotle and Plato; whereof both intermingled final causes, the one as a part of theology, and the other as a part of logic, which were the favourite studies respectively of both those persons. Not because those final causes are not true, and worthy to be inquired, being kept within their own province; but because their excursions into the limits of physical causes hath bred a vastness and solitude in that track. For, otherwise, keeping their precincts and borders, men are extremely deceived if they think there is an enmity or repugnancy at all between them. For, the cause rendered, that the hairs about the eye-lids are for the safe-guard of the sight, doth not impugn the cause rendered, that pilosity is incident to orifices of moisture; *Muscosi fontes, etc.* Nor the cause rendered, that the firmness of hides is for the armour of the body against extremities of heat and cold, doth not impugn the cause rendered, that contraction of pores is incident

to the outwardest parts, in regard of their adjacence to foreign or unlike bodies; and so of the rest: both causes being true and compatible, the one declaring an intention, the other a consequence only.

Neither doth this call in question, or derogate from divine providence, but highly confirms and exalts it. For as in civil actions he is the greater and deeper politician, that can make other men the instruments of his will and ends, and yet never acquaint them with his purpose, so as they shall do it, and yet not know what they do; than he that imparteth his meaning to those he employeth: so is the wisdom of God more admirable, when nature intendeth one thing, and providence draweth forth another; than if he had communicated to particular creatures, and motions, the characters and impressions of his providence. And thus much for metaphysic; the latter part whereof I allow as extant, but wish it confined to its proper place.

Nevertheless there remaineth yet another part of natural philosophy, which is commonly made a principal part, and holdeth rank with physic special, and metaphysic, which is mathematic; but I think it more agreeable to the nature of things, and to the light of order, to place it as a branch of metaphysic: for the subject of it being quantity, not quantity indefinite, which is but a relative, and belongeth to *philosphia prima*, as hath been said, but quantity determined, or proportionable; it appeareth to be one of the essential forms of things; as that that is causative in nature of a number of effects; insomuch as we see, in the schools both of Democritus and of Pythagoras, that the one did ascribe Figure to the first seeds of things, and the other did suppose Numbers to be the principles and originals of things; and it is true also, that of all other forms, as we understand forms, it is the most abstracted and separable from matter, and therefore most proper to metaphysic; which hath likewise been the cause why it hath been better laboured and inquired, than any of the other forms, which are more immersed into matter.

For it being the nature of the mind of man, to the extreme prejudice of knowledge, to delight in the spacious liberty of generalities, as in a champain region, and not in the inclosures of particularity; the mathematics of all other knowledge were the goodliest fields to satisfy that appetite.

But for the placing of these sciences, it is not much material; only we have endeavoured, in these our partitions, to observe a kind of perspective, that one part may cast light upon another.

The Mathematics are either pure or mixed. To the pure mathematics are those sciences belonging which handle quantity determinate, merely severed from any axioms of natural philosophy; and these are two, Geometry, and Arithmetic; the one handling quantity continued, and the other dissevered.

Mixed hath for subject some axioms or parts of natural philosophy, and considereth quantity determined, as it is auxiliary and incident unto them.

For many parts of nature can neither be invented with sufficient subtilty, nor demonstrated with sufficient perspicuity, nor accommodated unto use with sufficient dexterity, without the aid and intervening of the mathematics: of which sort are perspective, music, astronomy, cosmography, architecture, enginery, and divers others.

In the mathematics I can report no deficience, except it be that men do not sufficiently understand the excellent use of the pure mathematics, in that they do remedy and cure many defects in the wit and faculties intellectual. For, if the wit be too dull, they sharpen it; if too wandering, they fix it; if too inherent in the sense, they abstract it. So that as tennis is a game of no use in itself, but of great use in respect it maketh a quick eye, and a body ready to put itself into all postures; so in the mathematics, that use which is collateral and intervenient, is no less worthy than that which is principal and intended.

And as for the mixed mathematics, I may only make this prediction, that there cannot fail to be more kinds of them, as nature grows further disclosed.

Thus much of natural science, or the part of nature speculative.

For Natural Prudence, or the part operative of natural philosophy, we will divide it into three parts, experimental, philosophical, and magical; which three parts active have a correspondence and analogy with the three parts speculative, natural history, physic, and metaphysic: for many operations have been invented, sometimes by a casual incidence and occurrence, sometimes by a purposed experiment; and of those which have been found by an intentional experiment, some have been found out by varying, or extending the same experiment, some by transferring and compounding divers experiments the one into the other, which kind of invention an empiric may manage.

Again, by the knowledge of physical causes, there cannot fail to follow many indications and disignations of new particulars, if men in their speculation will keep an eye upon use and practice. But these are but coastings along the shore, *premendo littus iniquum*: for, it seemeth to me, there can hardly be discovered any radical or fundamental alterations and innovations in nature, either by the fortune and essays of experiments, or by the light and direction of physical causes.

Naturalis magia sive physica operativa major.

If therefore we have reported metaphysic deficient, it must follow, that we do the like of natural magic, which hath relation thereunto. For as for the natural magic whereof now there is mention in books, containing certain credulous and superstitious conceits and observations of sympathies, and antipathies, and hidden properties, and some frivolous experiments, strange rather by disguisement, than in themselves: it is as far differing in truth of nature from such a knowledge as we require, as the story of king Arthur of Britain, or Hugh of Bourdeaux, differs from Cæsar's commentaries in truth of story. For it is manifest that Cæsar did greater things *de vero*, than those imaginary heroes were feigned to do; but he did them not in that fabulous manner. Of

this kind of learning the fable of Ixion was a figure, who designed to enjoy Juno, the goddess of power; and instead of her had copulation with a cloud, of which mixture were begotten centaurs and chimeras.

So whosoever shall entertain high and vaporous imaginations, instead of a laborious and sober inquiry of truth, shall beget hopes and beliefs of strange and impossible shapes. And therefore we may note in these sciences, which hold so much of imagination and belief, as this degenerate natural magic, alchemy, astrology, and the like, that, in their propositions, the description of the means is ever more monstrous than the pretence or end.

For it is a thing more probable, that he that knoweth well the natures of weight, of colour, of pliant and fragile in respect of the hammer, of volatile and fixed in respect of the fire, and the rest, may superinduce upon some metal the nature and form of gold by such mechanic as belongeth to the production of the natures afore rehearsed, than that some grains of the medicine projected, should in a few moments of time turn a sea of quicksilver, or other material, into gold: so it is more probable, that he, that knoweth the nature of arefaction, the nature of assimilation, of nourishment to the thing nourished, the manner of increase and clearing of spirits, the manner of the depredations which spirits make upon the humours and solid parts; shall, by ambages of diets, bathings, anointings, medicines, motions, and the like, prolong life, or restore some degree of youth or vivicacity, than that it can be done with the use of a few drops, or scruples of a liquor or receipt. To conclude therefore, the true natural magic, which is that great liberty and latitude of operation, which dependeth upon the knowledge of forms, I may report deficient, as the relative thereof is; to which part, if we be serious, and incline not to vanities and plausible discourse, besides the deriving and deducing the operations themselves from metaphysic, there are pertinent two points of much purpose, the one by way of preparation, the other by way of caution: the first

is, that there be made a kalendar resembling an inventory of the estate of man, containing all the inventions, being the works or fruits of nature or art, which are now extant, and whereof man is already possessed, out of which doth naturally result a note, what things are yet held impossible or not invented: which kalender will be the more artificial and serviceable, if to every reputed impossibility you add what thing is extant, which cometh the nearest in degree to that impossibility; to the end, that by these optatives and potentials man's inquiry may be the more awake in deducing direction of works from the speculation of causes: and secondly, that those experiments be not only esteemed which have an immediate and present use, but those principally which are of most universal consequence for invention of other experiments, and those which give most light to the invention of causes; for the invention of the mariners needle, which giveth the direction, is of no less benefit for navigation, than the invention of the sails, which give the motion. Inventarium opum humanarum,

Thus have I passed through natural philosophy, and the deficiencies thereof, wherein if I have differed from the ancient and received doctries, and thereby shall move contradiction; for my part, as I affect not to dissent, so I purpose not to contend. If it be truth,

Non canimus surdis, respondent omnia sylvæ:

The voice of nature will consent, whether the voice of man do or no. And as Alexander Borgia was wont to say of the expedition of the French for Naples, that they came with chalk in their hands to mark up their lodgings, and not with weapons to fight: so I like better that entry of truth, which cometh peaceably with chalk to mark up those minds which are capable to lodge and harbour it, than that which cometh with pugnacity and contention.

But there remaineth a division of natural philosophy according to the report of the inquiry, and nothing concerning the matter or subject; and that is positive and considerative; when the inquiry reporteth either an assertion, or a doubt. These doubts,

or *non liquets*, are of two sorts, particular and total. For the first, we see a good example thereof in Aristotle's *Problems*, which deserved to have had a better continuance; but so nevertheless, as there is one point whereof warning is to be given and taken. The registring of doubts hath two excellent uses: The one, that it saveth philosophy from errors and falshoods, when that which is not fully appearing is not collected into assertion, whereby error might draw error, but reserved in doubt. The other, that the entry of doubts are as so many suckers or spunges to draw use of knowledge; insomuch, as that which, if doubts had not preceded, a man should never have advised, but passed it over without note, by the suggestion and solicitation of doubts is made to be attended and applied. But both these commodities do scarcely countervail an inconvenience which will intrude itself, if it be not debarred; which is, that, when a doubt is once received, men labor rather how to keep it a doubt still, than how to solve it, and accordingly bend their wits. Of this we see the familiar example in lawyers and scholars, both which, if they have once admitted a doubt, it goeth ever after authorised for a doubt. But that use of wit and knowledge is to be allowed, which laboreth to make doubtful things certain, and not those which labor to make certain things doubtful. Therefore these kalendars of doubts I commend as excellent things, so that there be this caution used, that when they be thoroughly sifted and brought to resolution, they be from thenceforth omitted, discarded, and not continued to cherish and encourage men in doubting. To which kalendar of doubts or problems, I advise to be annexed another kalendar, as much or more material, which is a kalendar of popular errors; I mean chiefly in natural history, such as pass in speech and conceit, and are nevertheless apparently detected and convicted of untruth, that man's knowledge be not weakened nor imbased by such dross and vanity.

Continuatio problematum in natura.

Catalogus falsitatum grassantium in historia naturæ.

As for the doubts or *non liquets* general or in total, I understand those differences of opinions touching

the principles of nature, and the fundamental points of the same which have caused the diversity of sects, schools, and philosophies, as that of Empedocles, Pythagoras, Democritus, Parmenides, and the rest. For although Aristotle, as though he had been of the race of the Ottomans, thought he could not reign, except the first thing he did he killed all his brethren; yet to those that seek truth and not magistrality, it cannot but seem a matter of great profit, to see before them the several opinions touching the foundations of nature: not for any exact truth that can be expected in those theories; for as the same phænomena in astronomy are satisfied by the received astronomy of the diurnal motion, and the proper motions of the planets, with their eccentrics, and epicyles; and likewise by the theory of Copernicus, who supposed the earth to move, and the calculations are indifferently agreeable to both: so the ordinary face and view of experience is many times satisfied by several theories and philosophies; whereas to find the real truth requireth another manner of severity and attention. For, as Aristotle saith, that children at the first will call every woman mother, but afterward they come to distinguish according to truth: so experience, if it be in childhood, will call every philosophy mother, but when it cometh to ripeness, it will discern the true mother; so as in the mean time it is good to see the several glosses and opinions upon nature, whereof it may be every one in some one point hath seen clearer than his fellows; therefore I wish some collection to be made painfully and understandingly *de antiquis philosophiis*, out of all the possible light which remaineth to us of them: which kind of work I find deficient. But here I must give warning, that it be done distinctly and severally, the philosophies of every one throughout by themselves, and not by titles packed and faggotted up together, as hath been done by Plutarch. For it is the harmony of a philosophy in itself which giveth it light and credence; whereas if it be singled and broken, it will seem more foreign and dissonant. For as when I read in Tacitus the

De antiquis philosophiis.

actions of Nero or Claudius, with circumstances of times, inducements and occasions, I find them not so strange; but when I read them in Suetonius Tranquillus, gathered into titles and bundles, and not in order of time, they seem more monstrous and incredible; so is it of any philosophy reported intire, and dismembered by articles. Neither do I exclude opinions of latter times to be likewise represented in this kalendar of sects of philosophy, as that of Theophrastus Paracelsus, eloquently reduced into an harmony by the pen of Severinus the Dane, and that of Tilesius, and his scholar Donius, being as a pastoral philosophy, full of sense, but of no great depth: and that of Fracastorius, who though he pretended not to make any new philosophy, yet did use the absoluteness of his own sense upon the old: and that of Gilbertus, our countryman, who revived, with some alterations and demonstrations, the opinions of Xenophanes: and any other worthy to be admitted.

Thus have we now dealt with two of the three beams of man's knowledge, that is, *Radius directus*, which is referred to nature; *Radius refractus*, which is referred to God, and cannot report truly because of the inequality of the medium; there resteth *Radius reflexus*, whereby man beholdeth and contemplateth himself.

We come therefore now to that knowledge whereunto the ancient oracle directeth us, which is the knowledge of ourselves; which deserveth the more accurate handling, by how much it toucheth us more nearly. This knowledge, as it is the end and term of natural philosophy in the intention of man, so, notwithstanding, it is but a portion of natural philosophy in the continent of nature; and generally let this be a rule, that all partitions of knowledges be accepted rather for lines and veins, than for sections and separations; and that the continuance and intireness of knowledge be preserved. For the contrary hereof hath made particular sciences to become barren, shallow, and erroneous, while they have not been

nourished and maintained from the common fountain. So we see Cicero the orator complained of Socrates and his school, that he was the first that separated philosophy and rhetoric, whereupon rhetoric became an empty and verbal art. So we may see, that the opinion of Copernicus touching the rotation of the earth, which astronomy itself cannot correct, because it is not repugnant to any of the phænomena, yet natural philosophy may correct. So we see also that the science of medicine, if it be destitute and forsaken by natural philosophy, it is not much better than an empirical practice.

With this reservation therefore we proceed to Human Philosophy, or humanity, which hath two parts: The one considereth man segregate or distributively: the other congregate or in society. So as human philosophy is either simple and particular, or conjugate and civil. Humanity particularly consisteth of the same parts whereof man consisteth, that is of knowledges which respect the body, and of knowledges that respect the mind; but before we distribute so far, it is good to constitute. For I do take the consideration in general, and at large, of human nature to be fit to be emancipated and make a knowledge by itself; not so much in regard of those delightful and elegant discourses which have been made of the dignity of man, of his miseries, of his state and life, and the like adjuncts of his common and undivided nature; but chiefly in regard of the knowledge concerning the sympathies and concordances between the mind and body, which being mixed, cannot be properly assigned to the sciences of either.

This knowledge hath two branches: for as all leagues and amities consist of mutual intelligence and mutual offices, so this league of mind and body hath these two parts, how the one discloseth the other, and how the one worketh upon the other; Discovery, and Impression.

The former of these hath begotten two arts, both of prediction or prenotion, whereof the one is honored with the inquiry of Aristotle, and the other of

Hippocrates. And although they have of later time been used to be coupled with superstitious and fantastical arts, yet being purged and restored to their true state, they have both of them a solid ground in nature, and a profitable use in life. The first is physiognomy, which discovereth the disposition of the mind by the lineaments of the body. The second is the exposition of natural dreams, which discovereth the state of the body by the imaginations of the mind. In the former of these I note a deficience, for Aristotle hath very ingeniously and diligently handled the factures of the body, but not the gestures of the body, which are no less comprehensible by art, and of greater use and advantage. For the lineaments of the body do disclose the disposition and inclination of the mind in general; but the motions of the countenance and parts do not only so, but do farther disclose the present humor and state of the mind and will. For, as your majesty saith most aptly and elegantly, "As the tongue speaketh to the ear, so the gesture speaketh to the eye." And therefore a number of subtle persons, whose eyes do dwell upon the faces and fashions of men, do well know the advantage of this observation, as being most part of their ability; neither can it be denied, but that it is a great discovery of dissimulations, and a great direction in business.

Pars physiognomiæ, de gestu sive motu corporis.

The latter branch touching impression, hath not been collected into art, but hath been handled dispersedly; and it hath the same relation or antistrophe that the former hath. For the consideration is double; "Either how, and how far the humors "and effects of the body do alter or work upon the "mind; or again, How, and how far the passions or "apprehensions of the mind do alter or work upon "the body." The former of these hath been inquired and considered, as a part and appendix of medicine, but much more as a part of religion or superstition: for the physician prescribeth cures of the mind in frenzies and melancholy passions, and pretendeth also to exhibit medicines to exhilarate the

mind, to confirm the courage, to clarify the wits, to corroborate the memory, and the like: but the scruples and superstitions of diet, and other regimen of the body, in the sect of the Pythagoreans, in the heresy of the Manicheans, and in the law of Mahomet, do exceed: So likewise the ordinances in the ceremonial law, interdicting the eating of the blood and fat, distinguishing between beasts clean and unclean for meat, are many and strict. Nay the faith itself, being clear and serene from all clouds of ceremony, yet retaineth the use of fastings, abstinences, and other macerations and humiliations of the body, as things real and not figurative. The root and life of all which prescripts is, besides the ceremony, the consideration of that dependency which the affections of the mind are submitted unto upon the state and disposition of the body. And if any man of weak judgment do conceive, that this suffering of the mind from the body, doth either question the immortality, or derogate from the sovereignty of the soul, he may be taught in easy instances, that the infant in the mother's womb is compatible with the mother, and yet separable: and the most absolute monarch is sometimes led by his servants, and yet without subjection. As for the reciprocal knowledge, which is the operation of the conceits and passions of the mind upon the body; we see all wise physicians, in the prescriptions of their regimens to their patients, do ever consider *accidentia animi*, as of great force to further or hinder remedies or recoveries; and more especially it is an inquiry of great depth and worth concerning imagination, how, and how far it altereth the body proper of the imaginant. For although it hath a manifest power to hurt, it followeth not it hath the same degree of power to help; no more than a man can conclude, that because there be pestilent airs, able suddenly to kill a man in health, therefore there should be sovereign airs, able suddenly to cure a man in sickness. But the inquisition of this part is of great use, though it needeth, as Socrates said, "a Delian "diver," being difficult and profound. But unto all

this knowledge *de communi vinculo*, of the concordances between the mind and the body, that part of inquiry is most necessary, which considereth of the seats and domiciles, which the several faculties of the mind do take and occupate in the organs of the body; which knowledge hath been attempted, and is controverted, and deserveth to be much better inquired. For the opinion of Plato, who placed the understanding in the brain, animosity (which he did unfitly call anger, having a greater mixture with pride) in the heart, and concupiscence or sensuality in the liver, deserveth not to be despised, but much less to be allowed. So then we have constituted, as in our own wish and advice, the inquiry touching human nature intire, as a just portion of knowledge to be handled apart.

The knowledge that concerneth man's Body, is divided as the good of man's body is divided, unto which it referreth. The good of man's body is of four kinds, health, beauty, strength, and pleasure: So the knowledges are medicine, or art of cure; art of decoration, which is called cosmetic; art of activity, which is called athletic; and art voluptuary, which Tacitus truly calleth *eruditus luxus*. The subject of man's body is of all other things in nature most susceptible of remedy; but then that remedy is most susceptible of error. For the same subtility of the subject doth cause large possibility, and easy failing; and therefore the inquiry ought to be the more exact.

To speak therefore of medicine, and to resume that we have said, ascending a little higher; the ancient opinion that man was *microcosmus*, an abstract or model of the world, hath been fantastically strained by Paracelsus and the alchemists, as if there were to be found in man's body certain correspondences and parallels, which should have respect to all varieties of things, as stars, planets, minerals, which are extant in the great world. But thus much is evidently true, that of all substances which nature hath produced, man's body is the most extremely

compounded: For we see herbs and plants are nourished by earth and water; beasts for the most part by herbs and fruits; man by the flesh of beasts, birds, fishes, herbs, grains, fruits, water, and the manifold alterations, dressings, and preparations of these several bodies, before they come to be his food and aliment. Add hereunto, that beasts have a more simple order of life, and less change of affections to work upon their bodies; whereas man in his mansion, sleep, exercise, passions, hath infinite variations, and it cannot be denied, but that the body of man of all other things is of the most compounded mass. The soul on the other side is the simplest of substances, as is well expressed:

Purumque reliquit
Æthereum sensum, atque auraï simplicis ignem.

So that it is do marvel though the soul so placed enjoy no rest, if that principle be true, that *Motus rerum est rapidus extra locum, placidus in loco.* But to the purpose: this variable composition of man's body hath made it as an instrument easy to distemper, and therefore the poets did well to conjoin music and medicine in Apollo, because the office of medicine is but to tune this curious harp of man's body, and to reduce it to harmony. So then the subject being so variable, hath made the art by consequence more conjectural; and the art being conjectural, hath made so much the more place to be left for imposture. For almost all other arts and sciences are judged by acts or master-pieces, as I may term them, and not by the successes and events. The lawyer is judged by the virtue of his pleading, and not by the issue of the cause. The master of the ship is judged by the directing his course aright, and not by the fortune of the voyage. But the physician, and perhaps the politician, hath no particular acts demonstrative of his ability, but is judged most by the event; which is ever but as it is taken: for who can tell, if a patient die or recover, or if a state be preserved or ruined, whether it be art or accident? And therefore many times the impostor is prized, and the man of

virtue taxed. Nay, we see the weakness and credulity of men is such, as they will often prefer a mountebank or witch before a learned physician. And therefore the poets were clear-sighted in discerning this extreme folly, when they made Æsculapius and Circe brother and sister, both children of the sun, as in the verses; Æn. vii. 772.

Ipse repertorem medicinæ talis et artis
Fulmine Phœbigenam Stygias detrusit ad undas:

And again,

Dives inaccessos ubi Solis filia lucos, etc. Æn. vii. 11.

For in all times, in the opinion of the multitude, witches, and old women, and impostors, have had a competition with physicians. And what followeth? Even this; that physicians say to themselves, as Soloman expresseth it upon an higher occasion; *If it befal to me, as befalleth to the fools, why should I labour to be more wise?* And therefore I cannot much blame physicians, that they use commonly to intend some other art or practice, which they fancy more than their profession. For you shall have of them, antiquaries, poets, humanists, statesmen, merchants, divines, and in every of these better seen than in their profession; and no doubt, upon this ground, that they find that mediocrity and excellency in their art maketh no difference in profit or reputation towards their fortune; for the weakness of patients, and sweetness of life, and nature of hope, maketh men depend upon physicians with all their defects. But, nevertheless, these things, which we have spoken of, are courses begotten between a little occasion, and a great deal of sloth and default; for if we will excite and awake our observation, we shall see, in familiar instances, what a predominant faculty the subtilty of spirit hath over the variety of matter or form: nothing more variable than faces and countenances, yet men can bear in memory the infinite distinctions of them; nay, a painter with a few shells of colours, and the benefit of his eye, and habit of his imagination, can imitate them all that ever have been, are, or may be, if they were brought before him. Nothing more

variable than voices, yet men can likewise discern them personally; nay, you shall have a buffoon, or *pantomimus*, will express as many as he pleaseth. Nothing more variable than the differing sounds of words, yet men have found the way to reduce them to a few simple letters. So that it is not the insufficiency or incapacity of man's mind, but it is the remote standing or placing thereof, that breedeth these mazes and incomprehensions: for as the sense afar off is full of mistaking, but is exact at hand, so it is of the understanding; the remedy whereof is not to quicken or strengthen the organ, but to go nearer to the object; and therefore there is no doubt, but if the physicians will learn and use the true approaches and avenues of nature, they may assume as much as the poet saith:

Et quoniam variant morbi, variabimus artes;
Mille mali species, mille salutis erunt.

Which that they should do, the nobleness of their art doth deserve, well shadowed by the poets, in that they made Æsculapius to be the son of the Sun, the one being the fountain of life, the other as the second stream; but infinitely more honoured by the example of our Saviour, who made the body of man the object of his miracles, as the soul was the object of his doctrine. For we read not that ever he vouchsafed to do any miracle about honor or money, except that one for giving tribute to Cæsar, but only about the preserving, sustaining, and healing the body of man.

Medicine is a science which hath been, as we have said, more professed than laboured, and yet more laboured than advanced; the labour having been, in my judgment, rather in circle than in progression. For I find much iteration, but small addition. It considereth the causes of diseases, with the occasions or impulsions; the diseases themselves, with the accidents; and the cures, with the preservations. The deficiences which I think good to note, being a few of many, and those such as are of a more open and manifest nature, I will enumerate and not place.

Narrationes medicinales.

The first is the discontinuance of the ancient and serious diligence of Hippocrates, who used to set down a narrative of the special cases of his patients, and how they proceeded, and how they were judged by recovery or death. Therefore having an example proper in the father of the art, I shall not need to alledge an example foreign, of the wisdom of the lawyers, who are careful to report new cases and decisions for the direction of future judgments. This continuance of Medicinal History I find deficient, which I understand neither to be so infinite as to extend to every common case, nor so reserved, as to admit none but wonders; for many things are new in the manner, which are not new in the kind; and if men will intend to observe, they shall find much worthy to observe.

Anatomia comparata.

In the inquiry which is made by anatomy, I find much deficience: for they inquire of the parts, and their substances, figures, and collocations; but they inquire not of the diversities of the parts, the secrecies of the passages, and the seats or nestling of the humours, nor much of the footsteps and impressions of diseases; the reason of which omission I suppose to be, because the first inquiry may be satisfied in the view of one or a few anatomies; but the latter being comparative and casual, must arise from the view of many. And as to the diversity of parts, there is no doubt but the facture or framing of the inward parts is as full of difference as the outward, and in that is the cause continent of many diseases, which not being observed, they quarrel many times with the humours, which are not in fault, the fault being in the very frame and mechanic of the part, which cannot be moved by medicine alterative, but must be accommodated and palliated by diets and medicines familiar. And for the passages and pores, it is true, which was anciently noted, that the more subtile of them appear not in anatomies, because they are shut and latent in dead bodies, though they be open and manifest in live: which being supposed, though the inhumanity of *anatomia vivorum* was by Celsus

justly reproved; yet in regard of the great use of this observation, the inquiry needed not by him so slightly to have been relinquished altogether, or referred to the casual practices of surgery, but might have been well diverted upon the dissection of beasts alive, which, notwithstanding the dissimilitude of their parts, may sufficiently satisfy this inquiry. And for the humours, they are commonly passed over in anatomies as purgaments, whereas it is most necessary to observe, what cavities, nests, and receptacles the humours do find in the parts, with the differing kind of the humour so lodged and received. And as for the footsteps of diseases, and their devastations of the inward parts, impostumations, exulcerations, discontinuations, putrefactions, consumptions, contractions, extensions, convulsions, dislocations, obstructions, repletions, together with all preternatural substances, as stones, carnosities, excrescences, worms, and the like; they ought to have been exactly observed by multitude of anatomies, and the contribution of mens several experiences, and carefully set down, both historically, according to the appearances, and artificially, with a reference to the diseases and symptoms which resulted from them, in case where the anatomy is of a defunct patient; whereas now upon opening of bodies, they are passed over slightly and in silence.

Inquisitio ulterior de morbis insanabilibus.

In the inquiry of diseases they do abandon the cures of many, some as in their nature incurable, and others as past the period of cure; so that Sylla and the triumvirs never proscribed so many men to die, as they do by their ignorant edicts, whereof numbers do escape with less difficulty, than they did in the Roman proscriptions. Therefore I will not doubt to note as a deficience, that they inquire not the perfect cures of many diseases, or extremities of diseases, but pronouncing them incurable, do enact a law of neglect, and exempt ignorance from discredit.

De euthanasia exteriore.

Nay farther, I esteem it the office of a physician not only to restore health, but to mitigate pain and dolors, and not only when such mitigation may con-

duce to recovery, but when it may serve to make a fair and easy passage: for it is no small felicity which Augustus Cæsar was wont to wish to himself, that same *euthanasia*, and which was specially noted in the death of Antoninus Pius, whose death was after the fashion and semblance of a kindly and pleasant sleep. So it is written of Epicurus, that after his disease was judged desperate, he drowned his stomach and senses with a large draught and ingurgitation of wine; whereupon the epigram was made, *Hinc Stygias ebrius hausit aquas:* he was not sober enough to taste any bitterness of the Stygian water. But the physicians, contrariwise, do make a kind of scruple and religion to stay with the patient after the disease is deplored; whereas, in my judgment, they ought both to inquire the skill, and to give the attendances for the facilitating and asswaging of the pains and agonies of death.

Medicinæ experimentales.

In the consideration of the cures of diseases, I find a deficience in the receipts of propriety, respecting the particular cures of diseases: for the physicians have frustrated the fruit of tradition and experience by their magistralities, in adding, and taking out, and changing *quid pro quo*, in their receipts, at their pleasures, commanding so over the medicine, as the medicine cannot command over the disease; for except it be treacle and Mithridatum, and of late diascordium, and a few more, they tie themselves to no receipts severely and religiously: for as to the confections of sale which are in the shops, they are for readiness and not for propriety; for they are upon general intentions of purging, opening, comforting, altering, and not much appropriated to particular diseases; and this is the cause why empirics and old women are more happy many times in their cures than learned physicians, because they are more religious in holding their medicines. Therefore here is the deficience which I find, that physicians have not, partly out of their own practice, partly out of their constant probations reported in books, and partly out of the traditions of empirics, set down and delivered

over certain experimental medicines for the cure of particular diseases, besides their own conjectural and magisterial descriptions. For as they were the men of the best composition in the state of Rome, which either being consuls inclined to the people, or being tribunes inclined to the senate; so in the matter we now handle, they be the best physicians, which being learned, incline to the traditions of experience, or being empirics, incline to the methods of learning.

Imitatio naturæ in balneis, et aquis medicinalibus.

In preparation of medicines, I do find strange, especially considering how mineral medicines have been extolled, and that they are safer for the outward than inward parts, that no man hath sought to make an imitation by art of natural baths, and medicinable fountains; which nevertheless are confessed to receive their virtues from minerals; and not so only, but discerned and distinguished from what particular mineral they receive tincture, as sulphur, vitriol, steel, or the like; which nature, if it may be reduced to compositions of art, both the variety of them will be increased, and the temper of them will be more commanded.

Filum medicinale, sive de vicibus medicinarum.

But lest I grow to be more particular than is agreeable, either to my intention or to proportion; I will conclude this part with the note of one deficience more, which seemeth to me of greatest consequence; which is, that the prescripts in use are too compendious to attain their end; for to my understanding, it is a vain and flattering opinion to think any medicine can be so sovereign, or so happy, as that the receipt or use of it can work any great effect upon the body of man: it were a strange speech, which spoken, or spoken oft, should reclaim a man from a vice to which he were by nature subject; it is order, pursuit, sequence, and interchange of application, which is mighty in nature; which although it require more exact knowledge in prescribing, and more precise obedience in observing, yet is recompensed with the magnitude of effects. And although a man would think by the daily visitations of the physicians, that there were a pursuance in the cure; yet let a

man look into their prescripts and ministrations, and he shall find them but inconstancies, and every day's devices without any settled providence or project; not that every scrupulous or superstitious prescript is effectual, no more than every strait way is the way to heaven, but the truth of the direction must precede severity of observance.

For Cosmetic, it hath parts civil, and parts effeminate: for cleanness of body was ever esteemed to proceed from a due reverence to God, to society, and to ourselves. As for artificial decoration, it is well worthy of the deficiences which it hath; being neither fine enough to deceive, nor handsome to use, nor wholesome to please.

For Athletic, I take the subject of it largely, that is to say, for any point of ability, whereunto the body of man may be brought, whether it be of activity, or of patience; whereof activity hath two parts, strength and swiftness: and patience likewise hath two parts, hardness against wants and extremities, and indurance of pain or torment, whereof we see the practices in tumblers, in savages, and in those that suffer punishment: nay, if there be any other faculty which falls not within any of the former divisions, as in those that dive, that obtain a strange power of containing respiration, and the like, I refer it to this part. Of these things the practices are known, but the philosophy that concerneth them is not much inquired; the rather, I think, because they are supposed to be obtained, either by an aptness of nature, which cannot be taught, or only by continual custom, which is soon prescribed; which though it be not true, yet I forbear to note any deficiences, for the Olympian games are down long since, and the mediocrity of these things is for use; as for the excellency of them, it serveth for the most part for mercenary ostentation.

For arts of Pleasure sensual, the chief deficience in them is of laws to repress them. For as it hath been well observed, that the arts which flourish in times while virtue is in growth, are military, and

while virtue is in state, are liberal, and while virtue is in declination, are voluptuary; so I doubt, that this age of the world is somewhat upon the descent of the wheel. With arts voluptuary I couple practices joculary; for the deceiving of the senses is one of the pleasures of the senses. As for games of recreation, I hold them to belong to civil life and education. And thus much of that particular human philosophy which concerns the body, which is but the tabernacle of the mind.

For Human Knowledge, which concerns the Mind, it hath two parts, the one that inquireth of the substance or nature of the soul or mind, the other that inquireth of the faculties or functions thereof.

Unto the first of these, the considerations of the original of the soul, whether it be native or adventive, and how far it is exempted from laws of matter, and of the immortality thereof, and many other points, do appertain; which have been not more laboriously inquired than variously reported; so as the travel therein taken, seemeth to have been rather in a maze than in a way. But although I am of opinion, that this knowledge may be more really and soundly inquired even in nature than it hath been; yet I hold, that in the end it must be bounded by religion, or else it will be subject to deceit and delusion: for as the substance of the soul in the creation was not extracted out of the mass of heaven and earth, by the benediction of a *producat*, but was immediately inspired from God; so it is not possible that it should be, otherwise than by accident, subject to the laws of heaven and earth, which are the subject of philosophy; and therefore the true knowledge of the nature and state of the soul, must come by the same inspiration that gave the substance. Unto this part of knowledge touching the soul there be two appendixes, which, as they have been handled, have rather vapoured forth fables than kindled truth, divination, and fascination.

Divination hath been anciently and fitly divided into

artificial and natural; whereof artificial is, when the mind maketh a prediction by argument, concluding upon signs and tokens; natural is, when the mind hath a presention by an internal power, without the inducement of a sign. Artificial is of two sorts, either when the argument is coupled with a derivation of causes, which is rational; or when it is only grounded upon a coincidence of the effect, which is experimental; whereof the latter for the most part is superstitious: such as were the heathen observations upon the inspection of sacrifices, the flights of birds, the swarming of bees, and such as were the Chaldean astrology, and the like. For artificial divination, the several kinds thereof are distributed amongst particular knowledges. The astronomer hath his predictions, as of conjunctions, aspects, eclipses, and the like. The physician hath his predictions of death, of recovery, of the accidents and issues of diseases. The politician hath his predictions; *O urbem venalem, et cito perituram, si emptorem invenerit!* which stayed not long to be performed in Sylla first, and after in Cæsar; so as these predictions are now impertinent, and to be referred over. But the divination which springeth from the internal nature of the soul, is that which we now speak of, which hath been made to be of two sorts, primitive and by influxion. Primitive is grounded upon the supposition, that the mind, when it is withdrawn and collected into itself, and not diffused into the organs of the body, hath some extent and latitude of prenotion, which therefore appeareth most in sleep, in extasies, and near death, and more rarely in waking apprehensions; and is induced and furthered by those abstinences and observances which make the mind most to consist in itself. By influxion, is grounded upon the conceit that the mind, as a mirror or glass, should take illumination from the foreknowledge of God and spirits; unto which the same regimen doth likewise conduce. For the retiring of the mind within itself, is the state which is most susceptible of divine influxions, save that it is accompanied in this case with a fervency

and elevation, which the ancients noted by fury, and not with a repose and quiet, as it is in the other.

Fascination is the power and act of imagination intensive upon other bodies than the body of the imaginant: for of that we spake in the proper place; wherein the school of Paracelsus, and the disciples of pretended natural magic, have been so intemperate, as that they have exalted the power of the imagination to be much one with the power of miracle-working faith: others, that draw nearer to probability, calling to their view the secret passages of things, and especially of the contagion that passeth from body to body, do conceive it should likewise be agreeable to nature, that there should be some transmissions and operations from spirit to spirit, without the mediation of the senses: whence the conceits have grown, now almost made civil, of the mastering spirit, and the force of confidence, and the like. Incident unto this is the inquiry how to raise and fortify the imagination; for if the imagination fortified have power, then it is material to know how to fortify and exalt it. And herein comes in crookedly and dangerously, a palliation of a great part of ceremonial magic. For it may be pretended, that ceremonies, characters, and charms, do work, not by any tacit or sacramental contract with evil spirits, but serve only to strengthen the imagination of him that useth it: as images are said by the Roman church to fix the cogitations, and raise the devotions of them that pray before them. But for mine own judgment, if it be admitted that imagination hath power, and that ceremonies fortify imagination, and that they be used sincerely and intentionally for that purpose; yet I should hold them unlawful, as opposing to that first edict which God gave unto man, *In sudore vultus comedes panem tuum.* For they propound those noble effects, which God hath set forth unto man to be bought at the price of labour, to be attained by a few easy and slothful observances. Deficiences in these knowledges I will report none, other than the ge-

neral deficience, that it is not known how much of them is verity, and how much vanity.

The knowledge which respecteth the faculties of the mind of man, is of two kinds; the one respecting his understanding and reason, and the other his will, appetite, and affection; whereof the former produceth position or decree, the latter action or execution. It is true that the imagination is an agent or *nuncius* in both provinces, both the judicial and the ministerial. For sense sendeth over to imagination before reason have judged, and reason sendeth over to imagination before the decree can be acted: for imagination ever precedeth voluntary motion, saving that this Janus of imagination hath differing faces; for the face towards reason hath the print of truth, but the face towards action hath the print of good, which nevertheless are faces,

Quales decet esse sororum.

Neither is the imagination simply and only a messenger, but is invested with, or at leastwise usurpeth no small authority in itself, besides the duty of the message. For it was well said by Aristotle, "That "the mind hath over the body that commandment, "which the lord hath over a bondman; but that rea- "son hath over the imagination that commandment "which a magistrate hath over a free citizen," who may come also to rule in his turn. For we see that in matters of faith and religion, we raise our imagination above our reason, which is the cause why religion sought ever access to the mind by similitudes, types, parables, visions, dreams. And again, in all persuasions, that are wrought by eloquence, and other impressions of like nature, which do paint and disguise the true appearance of things, the chief recommendation unto reason is from the imagination. Nevertheless, because I find not any science that doth properly or fitly pertain to the imagination, I see no cause to alter the former division. For as for poesy, it is rather a pleasure, or play of imagination, than a work of duty thereof. And if it be a work, we speak

not now of such parts of learning as the imagination produceth, but of such sciences as handle and consider of the imagination; no more than we shall speak now of such knowledges as reason produceth, for that extendeth to all philosophy, but of such knowledges as do handle and inquire of the faculty of reason; so as poesy had its true place. As for the power of the imagination in nature, and the manner of fortifying the same, we have mentioned it in the doctrine *De anima*, whereunto most fitly it belongeth: and lastly, for imaginative or insinuative reason, which is the subject of rhetoric, we think it best to refer it to the arts of reason. So therefore we content ourselves with the former division, that Human Philosophy, which respecteth the faculties of the mind of man hath two parts, Rational and Moral.

The part of Human Philosophy which is Rational, is of all knowledges, to the most wits, the least delightful, and seemeth but a net of subtilty and spinosity: for as it was truly said, that knowledge is *pabulum animi*; so in the nature of mens appetite to this food, most men are of the taste and stomach of the Israelites in the desert, that would fain have returned *ad ollas carnium*, and were weary of manna; which though it were celestial, yet seemed less nutritive and comfortable. So generally men taste well knowledges that are drenched in flesh and blood, civil history, morality, policy, about the which mens affections, praises, fortunes, do turn and are conversant; but this same *lumen siccum* doth parch and offend most mens watery and soft natures. But to speak truly of things as they are in worth, *rational knowledges* are the keys of all other arts; for as Aristotle saith aptly and elegantly, "That the hand is the "instrument of instruments, and the mind is the "form of forms;" so these be truly said to be the art of arts; neither do they only direct, but likewise confirm and strengthen: even as the habit of shooting doth not only enable to shoot a nearer shoot, but also to draw a stronger bow.

The arts intellectual are four in number, divided

according to the ends whereunto they are referred; for man's labour is to invent that which is sought or propounded; or to judge that which is invented; or to retain that which is judged; or to deliver over that which is retained. So as the arts must be four; art of inquiry or invention; art of examination or judgment; art of custody or memory; and art of elocution or tradition.

Invention is of two kinds, much differing; the one of arts and sciences, and the other of speech and arguments. The former of these I do report deficient; which seemeth to me to be such a deficience, as if in the making of an inventory, touching the state of a defunct, it should be set down, That there is no ready money. For as money will fetch all other commodities, so this knowledge is that which should purchase all the rest. And like as the West-Indies had never been discovered, if the use of the mariner's needle had not been first discovered, though the one be vast regions, and the other a small motion; so it cannot be found strange, if sciences be no farther discovered, if the art itself of invention and discovery hath been passed over.

That this part of knowledge is wanting to my judgment, standeth plainly confessed: for first, logic doth not pretend to invent sciences, or the axioms of sciences, but passeth it over with a *cuique in sua arte credendum*. And Celsus acknowledgeth it gravely, speaking of the empirical and dogmatical sects of physicians, "That medicines and cures were first "found out, and then after the reasons and causes "were discoursed; and not the causes first found "out, and by light from them the medicines and "cures discovered." And Plato, in his *Theætetus*, noteth well, "That particulars are infinite, and the "higher generalities give no sufficient direction; "and that the pith of all sciences, which maketh the "artsman differ from the inexpert, is in the middle "propositions, which in every particular knowledge "are taken from tradition and experience." And therefore we see, that they which discourse of the in-

ventions and originals of things, refer them rather to chance than to art, and rather to beasts, birds, fishes, serpents, than to men.

Dictamnum genetrix Cretæa carpit ab Ida,
Puberibus caulem foliis, et flore comantem
Purpureo: non illa feris incognita capris,
Gramina cum tergo volucres hæsere sagittæ.

So that it was no marvel, the manner of antiquity being to consecrate inventors, that the Ægyptians had so few human idols in their temples, but almost all brute.

Omnigenumque Deum monstra, et latrator Anubis,
Contra Neptunum, et Venerem, contraque Minervam,
etc.

And if you like better the tradition of the Grecians, and ascribe the first inventions to men, yet you will rather believe that Prometheus first struck the flints, and marvelled at the spark, than that when he first struck the flints he expected the spark; and therefore we see the West-Indian Prometheus had no intelligence with the European, because of the rareness with them of flint, that gave the first occasion: so as it should seem, that hitherto men are rather beholden to a wild goat for surgery, or to a nightingale for music, or to the ibis for some part of physic, or to the potlid that flew open for artillery, or generally to chance, or any thing else, than to logic, for the invention of arts and sciences. Neither is the form of invention which Virgil describeth much other.

Ut varias usus meditando extunderet artes
Paulatim.

For if you observe the words well, it is no other method than that which brute beasts are capable of and do put in use: which is a perpetual intending or practising some one thing, urged and imposed by an absolute necessity of conservation of being; for so Cicero saith very truly, *Usus uni rei deditus, et naturam et artem sæpe vincit.* And therefore if it be said of men,

Labor omnia vincit
Improbus, et duris urgens in rebus ejestas;

it is likewise said of beasts, *Quis psittaco docuit suum χαῖρε*; Who taught the raven in a drought to throw pebbles into an hollow tree, where she espied water, that the water might rise so as she might come to it? Who taught the bee to sail through such a vast sea of air, and to find the way from a field in flower, a great way off, to her hive? Who taught the ant to bite every grain of corn that she burieth in her hill, lest it should take root and grow? Add then the word *extundere*, which importeth the extreme difficulty; and the word *paulatim*, which importeth the extreme slowness; and we are where we were, even amongst the Ægyptians gods; there being little left to the faculty of reason, and nothing to the duty of art, for matter of invention.

Secondly, the induction which the logicians speak of, and which seemeth familiar with Plato, whereby the principles of sciences may be pretended to be invented, and so the middle propositions by derivation from the principles; their form of induction, I say, is utterly vicious and incompetent; wherein their error is the fouler, because it is the duty of art to perfect and exalt nature; but they contrariwise have wronged, abused, and traduced nature. For he that shall attentively observe how the mind doth gather this excellent dew of knowledge, like unto that which the poet speaketh of, *Aërei mellis cœlestia dona*, distilling and contriving it out of particulars natural and artificial, as the flowers of the field and garden, shall find, that the mind of herself by nature doth manage and act an induction much better than they describe it. For to conclude upon an enumeration of particulars without instance contradictory, is no conclusion, but a conjecture; for who can assure, in many subjects, upon those particulars which appear of a side, that there are not other on the contrary side which appear not. As if Samuel should have rested upon those sons of Jesse, which were brought before him, and failed of David which was in the field. And this form, to say truth, is so gross, as it had not been possible for wits so subtile, as have managed these

things, to have offered it to the world, but that they hasted to their theories and dogmaticals, and were imperious and scornful toward particulars, which their manner was to use but as *lictores* and *viatories*, for serjeants and whifflers, *ad summovendam turbam*, to make way and make room for their opinions, rather than in their true use and service: certainly it is a thing may touch a man with a religious wonder to see how the footsteps of seducement are the very same in divine and human truth; for as in divine truth man cannot endure to become as a child; so in human, they reputed the attending the inductions, whereof we speak, as if it were a second infancy or childhood.

Thirdly, allow some principles or axioms were rightly induced, yet nevertheless certain it is, that middle propositions cannot be deduced from them in subject of nature by syllogism, that is, by touch and reduction of them to principles in a middle term. It is true that in sciences popular, as moralities, laws, and the like: yea and divinity, because it pleaseth God to apply himself to the capacity of the simplest, that form may have use, and in natural philosophy likewise, by way of argument or satisfactory reason, *Quæ assensum parit, operis effœta est;* but the subtilty of nature and operations will not be inchained in those bonds: for arguments consist of propositions, and propostions of words, and words are but the current tokens or marks of popular notions of things; which notions, if they be grossly and variably collected out of particulars, it is not the laborious examination either of consequences of arguments, or of the truth of propositions, that can ever correct that error, being, as the physicians speak, in the first digestion; and therefore it was not without cause, that so many excellent philosophers became sceptics and academics, and denied any certainty of knowledge or comprehension, and held opinion, that the knowledge of man extended only to appearances and probabilities. It is true, that in Socrates it was supposed to be but a form of irony, *Scientiam dissimulando simulavit:* for he

used to disable his knowledge, to the end to enhance his knowledge, like the humour of Tiberius in his beginnings, that would reign, but would not acknowledge so much; and in the later academy, which Cicero embraced, this opinion also of *acatalepsia*, I doubt, was not held sincerely: for that all those which excelled in *copia* of speech, seem to have chosen that sect as that which was fittest to give glory to their eloquence, and variable discourses; being rather like progresses of pleasure, than journeys to an end. But assuredly many scattered in both academies did hold it in subtilty and integrity. But here was their chief error; they charged the deceit upon the senses, which in my judgment, notwithstanding all their cavillations, are very sufficient to certify and report truth, though not always immediately, yet by comparison, by help of instrument, and by producing and urging such things as are too subtile for the sense, to some effect comprehensible by the sense; and other like assistance. But they ought to have charged the deceit upon the weakness of the intellectual powers, and upon the manner of collecting and concluding upon the reports of the senses. This I speak not to disable the mind of man, but to stir it up to seek help: for no man, be he never so cunning or practised, can make a straight line or perfect circle by steadiness of hand, which may be easily done by help of a ruler or compass.

Experientia literata, et interpretatio naturæ.

This part of invention, concerning the invention of sciences, I purpose, if God give me leave, hereafter to propound, having digested it into two parts; whereof the one I term *experientia literata*, and the other, *interpretatio naturæ:* the former being but a degree and rudiment of the latter. But I will not dwell too long, nor speak too much upon a promise.

The invention of speech or argument is not properly an invention; for to invent, is to discover that we know not, and not to recover or resummon that which we already know; and the use of this invention is no other, but out of the knowledge, whereof our mind is already possessed, to draw forth or call before

us that which may be pertinent to the purpose which we take into our consideration. So as, to speak truly, it is no invention, but a remembrance or suggestion, with an application; which is the cause why the schools do place it after judgment, as subsequent and not precedent. Nevertheless, because we do account it a chace, as well of deer in an inclosed park, as in a forest at large, and that it hath already obtained the name; let it be called invention, so as it be perceived and discerned that the scope and end of this invention is readiness and present use of our knowledge, and not addition or amplification thereof.

To procure this ready use of knowledge there are two courses, preparation and suggestion. The former of these seemeth scarcely a part of knowledge, consisting rather of diligence than of any artificial erudition. And herein Aristotle wittily, but hurtfully, doth deride the sophists near his time, saying, "They did as if one that professed the art of shoe-"making should not teach how to make up a shoe, "but only exhibit in a readiness a number of shoes "of all fashions and sizes." But yet a man might reply, that if a shoemaker should have no shoes in his shop but only work as he is bespoken, he should be weakly customed. But our Saviour, speaking of divine knowledge, saith, *that the kingdom of heaven is like a good housholder, that bringeth forth new and old store:* and we see the ancient writers of rhetoric do give it in precept, that pleaders should have the places whereof they have most continual use, ready handled in all the variety that may be; as that, to speak for the literal interpretation of the law against equity, and contrary; and to speak for presumptions and inferences against testimony, and contrary. And Cicero himself, being broken unto it by great experience, delivereth it plainly: that whatsoever a man shall have occasion to speak of, if he will take the pains, may have it in effect premeditate, and handled *in thesi:* so that when he cometh to a particular, he shall have nothing to do, but to add names, and times, and places, and such other circumstances of indi-

viduals. We see likewise the exact diligence of Demosthenes, who in regard of the great force that the entrance and access into causes hath to make a good impression, had ready framed a number of prefaces for orations and speeches. All which authorities and precedents may overweigh Aristotle's opinion, that would have us change a rich wardrobe for a pair of shears.

But the nature of the collection of this provision or preparatory store, though it be common both to logic and rhetoric, yet having made an entry of it here, where it came first to be spoken of, I think fit to refer over the farther handling of it to rhetoric.

The other part of invention, which I term suggestion, doth assign and direct us to certain marks or places which may excite our mind to return and produce such knowledge, as it hath formerly collected, to the end we may make use thereof. Neither is this use, truly taken, only to furnish argument to dispute probably with others, but likewise to minister unto our judgment to conclude aright within ourselves. Neither may these places serve only to prompt our invention, but also to direct our inquiry. For a faculty of wise interrogating is half a knowledge. For as Plato saith, "Whosoever seeketh, knoweth that "which he seeketh for in a general notion, else how "shall he know it when he hath found it?" And therefore the larger your anticipation is, the more direct and compendious is your search. But the same places which will help us what to produce of that which we know already, will also help us, if a man of experience were before us, what questions to ask; or, if we have books and authors to instruct us, what points to search and revolve: so as I cannot report, that this part of invention, which is that which the schools call topics, is deficient.

Nevertheless topics are of two sorts, general and special. The general we have spoken to, but the particular hath been touched by some, but rejected generally as inartificial and variable. But leaving the humour which hath reigned too much in the schools,

which is, to be vainly subtile in a few things, which are within their command, and to reject the rest, I do receive particular topics, that is, places or directions of invention and inquiry in every particular knowledge, as things of great use, being mixtures of logic with the matter of sciences: for in these it holdeth, *Ars inveniendi adolescit cum inventis;* for as in going of a way, we do not only gain that part of the way which is passed, but we gain the better sight of that part of the way which remaineth; so every degree of proceeding in a science giveth a light to that which followeth, which light if we strengthen, by drawing it forth into questions or places of inquiry, we do greatly advance our pursuit.

Now we pass unto the arts of judgment, which handle the natures of proofs and demonstrations, which as to induction hath a coincidence with invention: for in all inductions, whether in good or vicious form, the same action of the mind which inventeth, judgeth; all one as in the sense: but otherwise it is in proof by syllogism; for the proof being not immediate, but by mean, the invention of the mean is one thing, and the judgment of the consequence is another; the one exciting only, the other examining. Therefore, for the real and exact form of judgment, we refer ourselves to that which we have spoken of interpretation of nature.

For the other judgment by syllogism, as it is a thing most agreeable to the mind of man, so it hath been vehemently and excellently laboured; for the nature of man doth extremely covet to have somewhat in his understanding fixed and immovable, and as a rest and support of the mind. And therefore as Aristotle endeavoureth to prove, that in all motion there is some point quiescent; and as he elegantly expoundeth the ancient fable of Atlas, that stood fixed, and bore up the heaven from falling, to be meant of the poles or axle-tree of heaven, whereupon the conversion is accomplished; so assuredly men have a desire to have an Atlas or axle-tree within, to keep them from fluctuation, which is like to a per-

petual peril of falling; therefore men did hasten to set down some principles about which the variety of their disputations might turn.

So then this art of judgment is but the reduction of propositions to principles in a middle term. The principles to be agreed by all, and exempted from argument: the middle term to be elected at the liberty of every man's invention; the reduction to be of two kinds, direct and inverted; the one when the proposition is reduced to the principle, which they term a probation ostensive; the other when the contradictory of the proposition is reduced to the contradictory of the principle, which is, that which they call *per incommodum*, or pressing an absurdity; the number of middle terms to be as the proposition standeth degrees more or less removed from the principle.

But this art hath two several methods of doctrine, the one by way of direction, the other by way of caution; the former frameth and setteth down a true form of consequence, by the variations and deflections from which errors and inconsequences may be exactly judged. Toward the composition and structure of which form it is incident to handle the parts thereof, which are propositions, and the parts of propositions, which are simple words; and this is that part of logic which is comprehended in the analytics.

The second method of doctrine was introduced for expedite use and assurance sake, discovering the more subtile forms of sophisms and illaqueations, with their redargutions, which is that which is termed elenches. For although in the more gross sorts of fallacies it happeneth, as Seneca maketh the comparison well, as in juggling feats, which though we know not how they are done, yet we know well it is not as it seemeth to be; yet the more subtile sort of them doth not only put a man besides his answer, but doth many times abuse his judgment.

This part concerning Elenches, is excellently handled by Aristotle in precept, but more excellently by Plato in example; not only in the persons of the

sophists, but even in Socrates himself, who professing to affirm nothing, but to infirm that which was affirmed by another, hath exactly expressed all the forms of objection, fallacy, and redargution. And although we have said that the use of this doctrine is for redargution; yet it is manifest, the degenerate and corrupt use is for caption and contradiction, which passeth for a great faculty, and no doubt is of very great advantage, though the difference, be good which was made between orators and sophisters, that the one is as the greyhound, which hath his advantage in the race, and the other as the hare, which hath her advantage in the turn, so as it is the advantage of the weaker creature.

But yet farther, this doctrine of Elenches hath a more ample latitude and extent, than is perceived; namely, unto divers parts of knowledge; whereof some are laboured and others omitted. For first, I conceive, though it may seem at first somewhat strange, that that part which is variably referred, sometimes to logic, sometimes to metaphysic, touching the common adjuncts of essences, is but an Elenche; for the great sophism of all sophisms being equivocation or ambiguity of words and phrase, especially of such words as are most general and intervene in every inquiry; it seemeth to me that the true and fruitful uses, leaving vain subtilties and speculations, of the inquiry of majority, minority, priority, posteriority, indentity, diversity, possibility, act, totality, parts, existence, privation, and the like, are but wise cautions against ambiguities of speech. So again, the distribution of things into certain tribes, which we call categories or predicaments, are but cautions against the confusion of definitions and divisions.

Secondly, there is a seducement that worketh by the strength of the impression, and not by the subtilty of the illaqueation, not so much perplexing the reason, as over-ruling it by power of the imagination. But this part I think more proper to handle when I shall speak of rhetoric.

But lastly, there is yet a much more important and profound kind of fallacies in the mind of man, which I find not observed or inquired at all, and think good to place here, as that which of all others appertaineth most to rectify judgment: the force whereof is such, as it doth not dazzle or snare the understanding in some particulars, but doth more generally and inwardly infect and corrupt the state thereof. For the mind of man is far from the nature of a clear and equal glass, wherein the beams of things should reflect according to their true incidence; nay, it is rather like an inchanted glass, full of superstition and imposture, if it be not delivered and reduced. For this purpose, let us consider the false appearances that are imposed upon us by the general nature of the mind, beholding them in an example or two, as first in that instance which is the root of all superstition, namely, that to the nature of the mind of all men it is consonant for the affirmative or active to effect, more than the negative or privative. So that a few times hitting, or presence, countervails oftimes failing, or absence; as was well answered by Diagoras to him that shewed him, in Neptune's temple, the great number of pictures of such as had escaped shipwreck, and had paid their vows to Neptune, saying, "Advise now, you that think it folly "to invocate Neptune in tempest. Yea, but, saith "Diagoras, where are they painted that are drowned?" Let us behold it in another instance, namely, "That "the spirit of man, being of an equal and uniform "substance, doth usually suppose and feign in nature "a greater equality and uniformity than is in truth." Hence it cometh that the mathematicians cannot satisfy themselves, except they reduce the motions of the celestial bodies to perfect circles, rejecting spiral lines, and labouring to be discharged of eccentrics. Hence it cometh, that whereas there are many things in nature, as it were *monodica, sui juris;* yet the cogitations of man do feign unto them relatives, parallels, and conjugates, whereas no such thing is; as they have feigned an element of fire to

keep square with earth, water, and air, and the like; nay, it is not credible, till it be opened, what a number of fictions and fancies, the similitude of human actions and arts, together with the making of man *communis mensura*, have brought into natural philosophy, not much better than the heresy of the Anthropomorphites, bred in the cells of gross and solitary monks, and the opinion of Epicurus, answerable to the same in heathenism, who supposed the gods to be of human shape. And therefore Velleius the Epicurean needed not to have asked, why God should have adorned the heavens with stars, as if he had been an Ædilis; one that should have set forth some magnificent shews or plays. For if that great work-master had been of an human disposition, he would have cast the stars into some pleasant and beautiful works and orders, like the frets in the roofs of houses; whereas one can scarce find a posture in square, or triangle, or straight line, amongst such an infinite number; so differing an harmony there is between the spirit of man, and the spirit of nature.

Let us consider, again, the false appearances imposed upon us by every man's own individual nature and custom, in that feigned supposition that Plato maketh of the cave; for certainly if a child were continued in a grot or cave under the earth until maturity of age, and came suddenly abroad, he would have strange and absurd imaginations. So in like manner, although our persons live in the view of heaven, yet our spirits are included in the caves of our own complexions and customs, which minister unto us infinite errors and vain opinions, if they be not recalled to examination. But hereof we have given many examples in one of the errors, or peccant humors, which we ran briefly over in our first book.

And lastly, let us consider the false appearances that are imposed upon us by words, which are framed and applied according to the conceit and capacities of the vulgar sort; and although we think we govern our words, and prescribe it well *Loquendum ut vul-*

gus, sentiendum ut sapientes; yet certain it is, that words, as a Tartar's bow, do shoot back upon the understanding of the wisest, and mightily intangle and pervert the judgment; so as it is almost necessary in all controversies and disputations, to imitate the wisdom of the mathematicians, in setting down in the very beginning the definitions of our words and terms, that others may know how we accept and understand them, and whether they concur with us or no. For it cometh to pass, for want of this, that we are sure to end there where we ought to have begun, which is in questions and differences about words. To conclude therefore, it must be confessed that it is not possible to divorce ourselves from these fallacies and false appearances, because they are inseparable from our nature and condition of life; so yet nevertheless the caution of them, for all elenches, as was said, are but cautions, doth extremely import the true conduct of human judgment. The particular elenches or cautions against these three false appearances, I find altogether deficient.

Elenchi magni, sive de idolis animi humani nativis et adventiis.

There remaineth one part of judgment of great excellency, which to mine understanding is so slightly touched, as I may report that also deficient; which is, the application of the differing kinds of proofs to the differing kinds of subjects; for there being but four kinds of demonstrations, that is, by the immediate consent of the mind or sense, by induction, by syllogism, and by congruity; which is that which Aristotle calleth demonstration in orb, or circle, and not *à notioribus;* every of these hath certain subjects in the matter of sciences, in which respectively they have chiefest use; and certain others, from which respectively they ought to be excluded, and the rigor and curiosity in requiring the more severe proofs in some things, and chiefly the facility in contenting ourselves with the more remiss proofs in others, hath been amongst the greatest causes of detriment and hindrance to knowledge. The distributions and assignations of demonstrations, according to the analogy of sciences, I note as deficient.

De analogia demonstrationum.

The custody or retaining of knowledge is either in writing or memory; whereof writing hath two parts, the nature of the character, and the order of the entry: for the art of characters, or other visible notes of words or things, it hath nearest conjugation with grammar; and therefore I refer it to the due place: for the disposition and collocation of that knowledge which we preserve in writing, it consisteth in a good digest of common-places, wherein I am not ignorant of the prejudice imputed to the use of common-place books, as causing a retardation of reading, and some sloth or relaxation of memory. But because it is but a counterfeit thing in knowledges to be forward and pregnant, except a man be deep and full, I hold the entry of common-places, to be a matter of great use and essence in studying, as that which assureth *copia* of invention, and contracteth judgment to strength. But this is true, that of the methods of common-places that I have seen, there is none of any sufficient worth, all of them carrying merely the face of a school, and not of a world, and referring to vulgar matters, and pedantical divisions, without all life, or respect to action.

For the other principal part of the custody of knowledge, which is memory, I find that faculty in my judgment weakly inquired of. An art there is extant of it; but it seemeth to me that there are better precepts than that art, and better practices of that art, than those received. It is certain the art, as it is, may be raised to points of ostentation prodigious: but in use, as it is now managed, it is barren, not burdensome, nor dangerous to natural memory, as is imagined, but barren; that is, not dexterous to be applied to the serious use of business and occasions. And therefore I make no more estimation of repeating a great number of names or words upon once hearing, or the pouring forth of a number of verses or rhimes *ex tempore*, or the making of a satirical simile of every thing, or the turning of every thing to a jest, or the falsifying or contradicting of every thing by cavil, or the like, whereof in the faculties

of the mind there is great *copia*, and such as by device and practice may be exalted to an extreme degree of wonder, than I do of the tricks of tumblers, funambuloes, baladines; the one being the same in the mind, that the other is in the body; matters of strangeness without worthiness.

This art of memory is but built upon two intentions; the one prenotion, the other emblem. Prenotion dischargeth the indefinite seeking of that we would remember, and directeth us to seek in a narrow compass; that is, somewhat that hath congruity with our place of memory. Emblem reduceth conceits intellectual to images sensible, which strike the memory more; out of which axioms may be drawn much more practical than that in use; and besides which axioms, there are divers more touching help of memory, not inferior to them. But I did in the beginning distinguish, not to report those things deficient, which are but only ill managed.

There remaineth the fourth kind of rational knowledge, which is transitive, concerning the expressing or transferring our knowledge to others, which I will term by the general name of tradition or delivery. Tradition hath three parts: the first concerning the organ of tradition; the second concerning the method of tradition; and the third, concerning the illustration of tradition.

For the organ of tradition, it is either speech or writing: for Aristotle saith well, "Words are the "images of cogitations, and letters are the images of "words;" but yet it is not of necessity that cogitations be expressed by the medium of words. For whatsoever is capable of sufficient differences, and those perceptible by the sense, is in nature competent to express cogitations. And therefore we see in the commerce of barbarous people, that understand not one another's language, and in the practice of divers that are dumb and deaf, that mens minds are expressed in gestures, though not exactly, yet to serve the turn. And we understand farther, that it is the use of China, and the kingdoms of the high Levant,

to write in characters real, which express neither letters nor words in gross, but things or notions; insomuch as countries and provinces, which understand not one another's language, can nevertheless read one another's writings, because the characters are accepted more generally than the languages do extend; and therefore they have a vast multitude of characters, as many, I suppose, as radical words.

These notes of cogitations are of two sorts; the one when the note hath some similitude or congruity with the notion; the other *ad placitum*, having force only by contract or acceptation. Of the former sort are hieroglyphics and gestures. For as to hieroglyphics, things of ancient use, and embraced chiefly by the Ægyptians, one of the most ancient nations, they are but as continued impresses and emblems. And as for gestures, they are as transitory hieroglyphics, and are to hieroglyphics as words spoken are to words written, in that they abide not: but they have evermore, as well as the other, an affinity with the things signified; as Periander, being consulted with how to preserve a tyranny newly usurped, bid the messenger attend and report what he saw him do, and went into his garden and topped all the highest flowers; signifying, that it consisted in the cutting off and keeping low of the nobility and grandees. *Ad placitum* are the characters real before mentioned, and words: although some have been willing by curious inquiry, or rather by apt feigning, to have derived imposition of names from reason and intendment; a speculation elegant, and by reason it searcheth into antiquity, reverent; but sparingly mixed with truth, and of small fruit. This portion of knowledge, touching the notes of things, and cogitations in general, I find not inquired, but deficient. And although it may seem of no great use, considering that words and writings by letters do far excel all the other ways; yet because this part concerneth, as it were, the mint of knowledge, for words are the tokens current and accepted for conceits, as moneys are for values, and that it is fit men be not ignorant that moneys may be

De notis rerum.

of another kind than gold and silver, I thought good to propound it to better inquiry.

Concerning speech and words, the consideration of them hath produced the science of Grammar; for man still striveth to reintegrate himself in those benedictions, from which by his fault he hath been deprived; and as he hath striven against the first general curse, by the invention of all other arts; so hath he sought to come forth of the second general curse, which was the confusion of tongues, by the art of grammar, whereof the use in a mother tongue is small; in a foreign tongue more; but most in such foreign tongues as have ceased to be vulgar tongues, and are turned only to learned tongues. The duty of it is of two natures; the one popular, which is for the speedy and perfect attaining languages, as well for intercourse of speech as for understanding of authors; the other philosophical, examining the power and nature of words, as they are the footsteps and prints of reason: which kind of analogy between words and reason is handled *sparsim*, brokenly, though not intirely; and therefore I cannot report it deficient, though I think it very worthy to be reduced into a science by itself.

Unto grammar also belongeth, as an appendix, the consideration of the accidents of words, which are measure, sound, and elevation or accent, and the sweetness and harshness of them: whence hath issued some curious observations in rhetoric, but chiefly poesy, as we consider it, in respect of the verse, and not of the argument; wherein though men in learned tongues do tie themselves to the ancient measures, yet in modern languages it seemeth to me, as free to make new measures of verses as of dances; for a dance is a measured pace, as a verse is a measured speech. In these things the sense is better judge than the art;

Cœnæ fercula nostræ,
Mallem convivis, quam placuisse cocis.

And of the servile expressing antiquity in an unlike and an unfit subject, it is well said, *Quod tempore antiquum videtur, id incongruitate est maxime novum.*

For ciphers, they are commonly in letters or alphabets, but may be in words. The kinds of ciphers, besides the simple ciphers, with changes, and intermixtures of nulls and non-significants, are many, according to the nature or rule of the infolding: wheel-ciphers, key-ciphers, doubles, *etc.* But the virtues of them, whereby they are to be preferred, are three; that they be not laborious to write and read; that they be impossible to decipher; and in some cases, that they be without suspicion. The highest degree whereof is to to write *omnia per omnia;* which is undoubtedly possible with a proportion quincuple at most, of the writing infolding, to the writing infolded, and no other restraint whatsoever. This art of ciphering hath for relative an art of deciphering, by supposition unprofitable, but as things are, of great use. For suppose that ciphers were well managed, there be multitudes of them which exclude the decipherer. But in regard of the rawness and unskilfulness of the hands through which they pass, the greatest matters are many times carried in the weakest ciphers.

In the enumeration of these private and retired arts, it may be thought I seek to make a great, muster-roll of sciences, naming them for shew and ostentation, and to little other purpose. But let those which are skilful in them judge, whether I bring them in only for appearance, or whether in that which I speak of them, though in few words, there be not some seed of proficience. And this must be remembered, that as there be many of great account in their countries and provinces, which when they come up to the seat of the estate, are but of mean rank, and scarcely regarded; so these arts being here placed with the principal and supreme sciences, seem petty things; yet to such as have chosen them to spend their labours and studies in them, they seem great matters.

For the method of tradition, I see it hath moved a controversy in our time. But as in civil business, if there be a meeting, and men fall at words, there is

commonly an end of the matter for that time, and no proceeding at all: so in learning, where there is much controversy, there is many times little inquiry. For this part of knowledge of method seemeth to me so weakly inquired, as I shall report it deficient.

Method hath been placed, and that not amiss, in logic, as a part of judgment; for as the doctrine of syllogisms comprehendeth the rules of judgment upon that which is invented, so the doctrine of method containeth the rules of judgment upon that which is to be delivered; for judgment precedeth delivery, as it followeth invention. Neither is the method or the nature of the tradition material only to the use of knowledge, but likewise to the progression of knowledge: for since the labour and life of one man cannot attain to perfection of knowledge, the wisdom of the tradition is that which inspireth the felicity of continuance and proceeding. And therefore the most real diversity of method, is of method referred to use, and method referred to progression, whereof the one may be termed magisterial, and the other of probation.

The latter whereof seemeth to be *via deserta et interclusa.* For as knowledges are now delivered, there is a kind of contract of error, between the deliverer and the receiver; for he that delivereth knowledge, desireth to deliver it in such form as may be best believed, and not as may be best examined: and he that receiveth knowledge, desireth rather present satisfaction, than expectant inquiry; and so rather not to doubt, than not to err; glory making the author not to lay open his weakness, and sloth making the disciple not to know his strength.

But knowledge, that is delivered as a thread to be spun on, ought to be delivered and intimated, if it were possible, in the same method wherein it was invented, and so is it possible of knowledge induced. But in this same anticipated and prevented knowledge, no man knoweth how he came to the knowledge which he hath obtained. But yet never-

theless, *secundum majus et minus*, a man may revisit and descend unto the foundations of his knowledge and consent; and so transplant it into another, as it grew in his own mind. For it is in knowledges, as it is in plants, if you mean to use the plant, it is no matter for the roots; but if you mean to remove it to grow, then it is more assured to rest upon roots than slips: so the delivery of knowledges, as it is now used, is as of fair bodies of trees without the roots; good for the carpenter, but not for the planter. But if you will have sciences grow, it is less matter for the shaft or body of the tree, so you look well to the taking up of the roots: of which kind of delivery the method of the mathematics, in that subject, hath some shadow; but generally I see it neither put in use nor put in inquisition, and therefore note it for deficient.

De methodo sincera, sive ad filios scientiarum.

Another diversity of method there is, which hath some affinity with the former, used in some cases by the discretion of the ancients, but disgraced since by the impostures of many vain persons, who have made it as a false light for their counterfeit merchandises; and that is, enigmatical and disclosed. The pretence whereof is to remove the vulgar capacities from being admitted to the secrets of knowledges, and to reserve them to selected auditors, or wits of such sharpness as can pierce the veil.

Another diversity of method, whereof the consequence is great, is the delivery of knowledge in aphorisms, or in methods; wherein we may observe, that it hath been too much taken into custom, out of a few axioms or observations upon any subject to make a solemn and formal art, filling it with some discourses, and illustrating it with examples, and digesting it into a sensible method; but the writing in aphorisms hath many excellent virtues, whereto the writing in method doth not approach.

For first it trieth the writer, whether he be superficial or solid: for aphorisms, except they should be ridiculous, cannot be made but of the pith and heart of sciences; for discourse of illustration is cut off,

recitals of examples are cut off; discourse of connection and order is cut off; descriptions of practice are cut off; so there remaineth nothing to fill the aphorisms, but some good quantity of observation: and therefore no man can suffice, nor in reason will attempt to write aphorisms, but he that is sound and grounded. But in methods,

Tantum series juncturaque pollet,
Tantum de medio sumptis accedit honoris;

as a man shall make a great shew of an art, which if it were disjointed, would come to little. Secondly, methods are more fit to win consent or belief; but less fit to point to action; for they carry a kind of demonstration in orb or circle, one part illuminating another, and therefore satisfy. But particulars being dispersed, do best agree with dispersed directions. And lastly, aphorisms, representing a knowledge broken, do invite men to inquire farther; whereas methods carrying the shew of a total, do secure men as if they were at farthest.

Another diversity of method, which is likewise of great weight, is, the handling of knowledge by assertions, and their proofs; or by questions, and their determinations; the latter kind whereof, if it be immoderately followed, is as prejudicial to the proceeding of learning, as it is to the proceeding of an army to go about to besiege every little fort or hold. For if the field be kept, and the sum of the enterprise pursued, those smaller things will come in of themselves; indeed a man would not leave some important place with an enemy at his back. In like manner, the use of confutation in the delivery of sciences ought to be very sparing; and to serve to remove strong preoccupations and prejudgments, and not to minister and excite disputations and doubts.

Another diversity of method is according to the subject or matter which is handled; for there is a great difference in the delivery of the mathematics, which are the most abstracted of knowledges, and policy, which is the most immersed; and howsoever contention hath been moved, touching an uniformity

of method in multiformity of matter; yet we see how that opinion, besides the weakness of it, hath been of ill desert towards learning, as that which taketh the way to reduce learning to certain empty and barren generalities; being but the very husks and shells of sciences, all the kernel being forced out and expulsed with the torture and press of the method: and therefore as I did allow well of particular topics for invention, so do I allow likewise of particular methods of tradition.

Another diversity of judgment in the delivery and teaching of knowledge, is according unto the light and presuppositions of that which is delivered; for that knowledge which is new and foreign from opinions received, is to be delivered in another form than that that is agreeable and familiar; and therefore Aristotle, when he thinks to tax Democritus, doth in truth commend him, where he saith, "If we "shall indeed dispute, and not follow after simili-"tudes," *etc.* For those, whose conceits are seated in popular opinions, need only but to prove or dispute: but those whose conceits are beyond popular opinions, have a double labour; the one to make themselves conceived, and the other to prove and demonstrate: so that it is of necessity with them to have recourse to similitudes and translations to express themselves. And therefore in the infancy of learning, and in rude times, when those conceits which are now trivial were then new, the world was full of parables and similitudes; for else would men either have passed over without mark, or else rejected for paradoxes that which was offered, before they had understood or judged. So in divine learning, we see how frequent parables and tropes are: for it is a rule, "That "whatsoever science is not consonant to presuppo-"sitions, must pray in aid of similitudes."

There be also other diversities of methods vulgar and received: as that of resolution or *analysis*, of constitution or *systasis*, of concealment or cryptic, *etc.* which I do allow well of, though I have stood upon those which are least handled and observed. All

De prudentia traditionis.

which I have remembered to this purpose, because I would erect and constitute one general inquiry, which seems to me deficient touching the wisdom of tradition.

But unto this part of knowledge concerning method, doth farther belong, not only the architecture of the whole frame of a work, but also the several beams and columns thereof, not as to their stuff, but as to their quantity and figure: and therefore method considereth not only the disposition of the argument or subject, but likewise the propositions; not as to their truth or matter, but as to their limitation and manner. For herein Ramus merited better a great deal in reviving the good rules of propositions, Καθόλε πρῶτον κατὰ παντος, *etc.* than he did in introducing the canker of epitomes; and yet, as it is the condition of human things, that, according to the ancient fables, "The most precious things have the most pernicious keepers:" it was so, that the attempt of the one made him fall upon the other. For he had need be well conducted, that should design to make axioms convertible; if he make them not withal circular, and *non promovent*, or incurring into themselves; but yet the intention was excellent.

The other considerations of method concerning propositions, are chiefly touching the utmost propositions, which limit the dimensions of sciences; for every knowledge may be fitly said, besides the profundity, which is the truth and substance of it that makes it solid, to have a longitude and a latitude, accounting the latitude towards other sciences, and the longitude towards action; that is, from the greatest generality, to the most particular precept: The one giveth rule how far one knowledge ought to intermeddle within the province of another, which is the rule they call καθαυτο: the other giveth rule, unto what degree of particularity a knowledge should descend which latter I find passed over in silence, being in my judgment the more material; for certainly there must be somewhat left to practice; but how much is worthy the inquiry. We see remote and superficial genera-

lities do but offer knowledge to scorn of practical men, and are no more aiding to practice, than an Ortelius's universal map is to direct the way between London and York. The better sort of rules have been not unfitly compared to glasses of steel unpolished; where you may see the images of things, but first they must be filed; so the rules will help, if they be laboured and polished by practice. But how chrystalline they may be made at the first, and how far forth they may be polished aforehand, is the question; the inquiry whereof seemeth to me deficient.

De productione axiomatum.

There hath been also laboured, and put in practice, a method, which is not a lawful method, but a method of imposture, which is, to deliver knowledges in such manner as men may speedily come to make a shew of learning, who have it not; such was the travel of Raymundus Lullius in making that art, which bears his name, not unlike to some books of typocosmy which have been made since, being nothing but a mass of words of all arts, to give men countenance, that those which use the terms might be thought to understand the art; which collections are much like a fripper's or broker's shop, that hath ends of every thing, but nothing of worth.

Now we descend to that part which concerneth the illustration of tradition, comprehended in that science which we call Rhetoric, or art of eloquence; a science excellent, and excellently well laboured. For although in true value it is inferior to wisdom, as it is said by God to Moses, when he disabled himself for want of this faculty, *Aaron shall be thy speaker, and thou shalt be to him as God.* Yet with people it is the more mighty: for so Solomon saith, *Sapiens corde appellabitur prudens, sed dulcis eloquio majora reperiet;* signifying, that profoundness of wisdom will help a man to a name or admiration, but that it is eloquence that prevaileth in an active life; and as to the labouring of it, the emulation of Aristotle with the rhetoricians of his time, and the experience of Cicero, hath made them in their works of rhetorics exceed themselves. Again, the excellency of examples

of eloquence in the orations of Demosthenes and Cicero, added to the perfection of the precepts of eloquence, hath doubled the progression in this art: and therefore the deficiences which I shall note, will rather be in some collections, which may as handmaids attend the art, than in the rules or use of the art itself.

Notwithstanding, to stir the earth a little about the roots of this science, as we have done of the rest; the duty and office of rhetoric is to apply reason to imagination for the better moving of the will: for we see reason is disturbed in the administration thereof by three means; by illaqueation or sophism, which pertains to logic; by imagination or impression, which pertains to rhetoric; and by passion or affection, which pertains to morality. And as in negotiation with others, men are wrought by cunning, by importunity, and by vehemency; so in this negociation within ourselves, men are undetermined by inconsequences, solicited and importuned by impressions or observations, and transported by passions. Neither is the nature of man so unfortunately built, as that those powers and arts should have force to disturb reason, and not to establish and advance it; for the end of logic is to teach a form of argument to secure reason, and not to intrap it. The end of morality, is to procure the affections to obey reason, and not to invade it. The end of rhetoric, is to fill the imagination to second reason, and not to oppress it; for these abuses of arts come in but *ex obliquo* for caution.

And therefore it was great injustice in Plato, though springing out of a just hatred of the rhetoricians of his time, to esteem of rhetoric but as a voluptuary art, resembling it to cookery, that did mar wholesome meats, and help unwholesome by variety of sauces, to the pleasure of the taste. For we see that speech is much more conversant in adorning that which is good, than in colouring that which is evil; for there is no man but speaketh more honestly than he can do or think; and it was excellently noted

by Thucydides in Cleon, that because he used to hold on the bad side in causes of estate, therefore he was ever inveighing against eloquence and good speech, knowing that no man can speak fair of courses sordid and base. And therefore as Plato said elegantly, "That Virtue, if she could be seen, would "move great love and affection:" so seeing that she cannot be shewed to the sense by corporal shape, the next degree is, to shew her to the imagination in lively representation: for to shew her to reason only in subtilty of argument, was a thing ever derided in Chrysippus, and many of the Stoics, who thought to thrust virtue upon men by sharp disputations and conclusions, which have no sympathy with the will of man.

Again, if the affections in themselves were pliant and obedient to reason, it were true, there should be no great use of persuasions and insinuations to the will, more than of naked proposition and proofs: but in regard of the continual mutinies and seditions of the affections,

Video meliora, proboque,
Deteriora sequor;

Reason would become captive and servile, if eloquence of persuasions did not practise and win the imagination from the affections part, and contract a confederacy between the reason and imagination against the affections; for the affections themselves carry ever an appetite to good, as reason doth. The difference is, that the affection beholdeth merely the present, reason beholdeth the future and sum of time. And therefore the present filling the imagination more, reason is commonly vanquished; but after that force of eloquence and persuasion hath made things future and remote appear as present, then upon revolt of the imagination reason prevaileth.

We conclude therefore, that rhetoric can be no more charged with the colouring of the worst part, than logic with sophistry, or morality with vice. For we know the doctrines of contraries are the same, though the use be opposite. It appeareth also, that

logic differeth from rhetoric, not only as the fist from the palm, the one close, the other at large; but much more in this, that logic handleth reason exact, and in truth; and rhetoric handleth it as it is planted in popular opinions and manners. And therefore Aristotle doth wisely place rhetoric as between logic on the one side, and moral or civil knowledge on the other, as participating of both: for the proofs and demonstrations of logic are toward all men indifferent and the same: but the proofs and persuasions of rhetoric ought to differ according to the auditors:

Orpheus in sylvis, inter delphinas Arion.

Which application, in perfection of idea, ought to extend so far, that if a man should speak of the same thing to several persons, he should speak to them all respectively, and several ways: though this politic part of eloquence in private speech, it is easy for the greatest orators to want; whilst by the observing their well graced forms of speech, they lose the volubility of application: and therefore it shall not be amiss to recommend this to better inquiry, not being curious whether we place it here, or in that part which concerneth policy.

De prudentia sermonis privati.

Now therefore will I descend to the deficiences, which, as I said, are but attendances: and first, I do not find the wisdom and diligence of Aristotle well pursued, who began to make a collection of the popular signs and colours of good and evil, both simple and comparative, which are as the sophisms of rhetoric, as I touched before. For example;

Colores boni et mali, simplicis et comparati.

SOPHISMA.

Quod laudatur, bonum: quod vituperatur, malum.

REDARGUTIO.

Laudat venales qui vult extrudere merces.
Malum est, malum est, inquit emptor; sed cum recesserit, tum gloriabitur.

The defects in the labour of Aristotle are three; one, that there be but a few of many; another, that their elenchus's are not annexed; and the third, that he conceived but a part of the use of them: for their use is not only in probation, but much more in im-

pression. For many forms are equal in signification, which are differing in impression; as the difference is great in the piercing of that which is sharp, and that which is flat, though the strength of the percussion be the same: for there is no man but will be a little more raised by hearing it said; "Your ene-" mies will be glad of this;"

Hoc Ithacus velit, et magno mercentur Atridæ;

than by hearing it said only, "This is evil for you."

Secondly, I do resume also that which I mentioned before, touching provision or preparatory store, for the furniture of speech and readiness of invention, which appeareth to be of two sorts; the one in resemblance to a shop of pieces unmade up, the other to a shop of things ready made up, both to be applied to that which is frequent and most in request: the former of these I will call *antitheta*, and the latter *formulæ*.

Antitheta are *theses* argued *pro et contra*, wherein men may be more large and laborious; but in such as are able to do it, to avoid prolixity of entry, I wish the seeds of the several arguments to be cast up into some brief and acute sentences, not to be cited, but to be as scanes or bottoms of thread, to be unwinded at large when they come to be used; supplying authorities and examples by reference. Antitheta rerum.

PRO VERBIS LEGIS.

Non est interpretatio, sed divinatio, quæ recedit à litera. Cum receditur à litera judex transit in legislatorem.

PRO SENTENTIA LEGIS.

Ex omnibus verbis est eliciendus sensus, qui interpretatur singula.

Formulæ are but decent and apt passages or conveyances of speech, which may serve indifferently for differing subjects; as of preface, conclusion, digression, transition, excusation, *etc.* For as in buildings there is great pleasure and use in the well-casting of the stair-cases, entries, doors, windows, and the like; so in speech, the conveyances and passages are of special ornament and effect.

A Conclusion in a Deliberative.

So may we redeem the faults passed, and prevent the inconveniences future.

There remain two *appendices* touching the tradition of knowledge, the one critical, the other pedantical; for all knowledge is either delivered by teachers, or attained by men's proper endeavours: and therefore as the principal part of tradition of knowledge concerneth chiefly writing of books, so the relative part thereof concerneth reading of books: whereunto appertain incidently these considerations. The first is concerning the true correction and edition of authors, wherein nevertheless rash diligence hath done great prejudice. For these critics have often presumed that that which they understood not, is false set down. As the priest, that where he found it written of St. Paul, *Demissus est per sportam*, mended his book, and made it *Demissus est per portam*, because *sporta* was an hard word, and out of his reading: and surely these errors, though they be not so palpable and ridiculous, are yet of the same kind. And therefore as it hath been wisely noted, the most corrected copies are commonly the least correct.

The second is concerning the exposition and explication of authors, which resteth in annotations and commentaries, wherein it is over usual to blanch the obscure places, and discourse upon the plain.

The third is concerning the times, which in many cases give great light to true interpretations.

The fourth is concerning some brief censure and judgment of the authors, that men thereby may make some election unto themselves what books to read.

And the fifth is concerning the syntax and disposition of studies, that men may know in what order or pursuit to read.

For pedantical knowledge, it containeth that difference of tradition which is proper for youth, whereunto appertain divers considerations of great fruit.

As first the timing and seasoning of knowledges; as with what to initiate them, and from what for a time to refrain them.

Secondly, the consideration where to begin with the easiest, and so proceed to the more difficult, and in what courses to press the more difficult, and then to turn them to the more easy; for it is one method to practice swimming with bladders, and another to practise dancing with heavy shoes.

A third is the application of learning according unto the propriety of the wits; for there is no defect in the faculties intellectual but seemeth to have a proper cure contained in some studies: as for example, if a child be bird-witted, that is, hath not the faculty of attention, the mathematics giveth a remedy thereunto, for in them, if the wit be caught away but a moment, one is to begin anew: and as sciences have a propriety towards faculties for cure and help, so faculties or powers have a sympathy towards sciences for excellency or speedy profiting; and therefore it is an inquiry of great wisdom what kinds of wits and natures are most proper for what sciences.

Fourthly, the ordering of exercises is matter of great consequence to hurt or help: for, as is well observed by Cicero, men in exercising their faculties, if they be not well advised, do exercise their faults, and get ill habits as well as good; so there is a great judgment to be had in the continuance and intermission of exercises. It were too long to particularize a number of other considerations of this nature; things but of mean appearance, but of singular efficacy: for as the wronging or cherishing of seeds or young plants, is that that is most important to their thriving; and as it was noted, that the first six kings, being in truth as tutors of the state of Rome in the infancy thereof, was the principal cause of the immense greatness of that state which followed; so the culture and manurance of minds in youth hath such a forcible, though unseen, operation, as hardly any length of time or contention of labour can countervail it afterwards. And it is not amiss to observe also, how small and mean faculties gotten by education, yet when they fall into great men or great

matters, do work great and important effects; whereof we see a notable example in Tacitus, of two stage players, Percennius and Vibulenus, who by their faculty of playing put the Pannonian armies into an extreme tumult and combustion; for there arising a mutiny amongst them, upon the death of Augustus Cæsar, Blæsus the lieutenant had committed some of the mutineers, which were suddenly rescued; whereupon Vibulenus got to be heard speak, which he did in this manner: "These poor innocent wretches "appointed to cruel death, you have restored to "behold the light: but who shall restore my brother "to me, or life unto my brother, that was sent hither "in message from the regions of Germany, to treat "of the common cause? And he hath murdered "him this last night by some of his fencers and "ruffians, that he hath about him for his execution-"ers upon soldiers. Answer, Blæsus, what is done "with his body? The mortalest enemies do not "deny burial; when I have performed my last "duties to the corpse with kisses, with tears, com-"mand me to be slain besides him, so that these my "fellows, for our good meaning, and our true hearts "to the legions, may have leave to bury us." With which speech he put the army into an infinite fury and uproar; whereas truth was he had no brother, neither was there any such matter, but he played it merely as if he had been upon the stage.

But to return, we are now come to a period of rational knowledges, wherein if I have made the divisions other than those that are received, yet would I not be thought to disallow all those divisions which I do not use; for there is a double necessity imposed upon me of altering the divisions. The one, because it differeth in end and purpose, to sort together those things which are next in nature, and those things which are next in use; for if a secretary of state should sort his papers, it is like in his study, or general cabinet, he would sort together things of a nature, as treaties, instructions, *etc.* but in his boxes, or particular cabinet, he would sort together those

that he were like to use together, though of several natures; so in this general cabinet of knowledge it was necessary for me to follow the divisions of the nature of things; whereas if myself had been to handle any particular knowledge, I would have respected the divisions fittest for use. The other, because the bringing in of the deficiences did by consequence alter the partitions of the rest; for let the knowledge extant, for demonstration sake, be fifteen, let the knowledge with the deficiences be twenty, the parts of fifteen are not the parts of twenty, for the parts of fifteen are three and five, the parts of twenty are two, four, five and ten; so as these things are without contradiction, and could not otherwise be.

We proceed now to that knowledge which considereth of the Appetite and Will of Man, whereof Solomon saith, *Ante omnia, fili, custodi cor tuum, nam inde procedunt actiones vitæ.* In the handling of this science, those which have written seem to me to have done as if a man that professeth to teach to write, did only exhibit fair copies of alphabets, and letters joined, without giving any precepts or directions for the carriage of the hand and framing of the letters; so have they made good and fair exemplars and copies, carrying the draughts and portraitures of good, virtue, duty, felicity; propounding them well described as the true objects and scopes of man's will and desires; but how to attain these excellent marks, and how to frame and subdue the will of man to become true and conformable to these pursuits, they pass it over altogether, or slightly and unprofitably; for it is not the disputing that moral virtues are in the mind of man by habit and not by nature, or the distinguishing that generous spirits are won by doctrines and persuasions, and the vulgar sort by reward and punishment, and the like scattered glances and touches, that can excuse the absence of this part.

The reason of this omission I suppose to be that

hidden rock whereupon both this and many other barks of knowledge have been cast away; which is, that men have despised to be conversant in ordinary and common matters, the judicious direction whereof nevertheless is the wisest doctrine, for life consisteth not in novelties nor subtilities, but contrariwise they have compounded sciences chiefly of a certain resplendent or lustrous mass of matter, chosen to give glory either to the subtility of disputations, or to the eloquence of discourses. But Seneca giveth an excellent check to eloquence: *Nocet illis eloquentia, quibus non rerum cupiditatem facet, sed sui.* Doctrine should be such as should make men in love with their lesson, and not with the teacher, being directed to the auditor's benefit, and not to the author's commendation; and therefore those are of the right kind which may be concluded as Demosthenes concludes his counsel, *Quæ si feceritis, non oratorem duntaxat in præsentia laudabitis, sed vosmetipsos etiam, non ita multo post statu rerum vestrarum meliore.* Neither needed men of so excellent parts to have despaired of a fortune, which the poet Virgil promised himself, and indeed obtained, who got as much glory of eloquence, wit, and learning in the expressing of the observations of husbandry, as of the heroical acts of Æneas:

Nec sum animi dubius, verbis ea vincere magnum
Quam sit, et angustis hunc addere rebus honorem.
Georg. iii. 289.

And surely if the purpose be in good earnest not to write at leisure that which men may read at leisure, but really to instruct and suborn action and active life, these georgics of the mind concerning the husbandry and tillage thereof, are no less worthy than the heroical descriptions of virtue, duty, and felicity. Wherefore the main and primitive division of moral knowledge seemeth to be into the Exemplar or Platform of Good, and the Regiment or Culture of the Mind; the one describing the nature of good, the other prescribing rules how to subdue, apply, and accommodate the will of man thereunto.

The doctrine touching the Platform or Nature of Good considereth it either simple or compared, either the kinds of good, or the degrees of good; in the latter whereof those infinite disputations which were touching the supreme degree thereof, which they term felicity, beatitude, or the highest good, the doctrines concerning which were as the heathen divinity, are by the christian faith discharged. And, as Aristotle saith, "That young men may be happy, "but not otherwise but by hope;" so we must all acknowledge our minority, and embrace the felicity which is by hope of the future world.

Freed therefore, and delivered from this doctrine of the philosophers heaven, whereby they feigned an higher elevation of man's nature than was, for we see in what an height of stile Seneca writeth, *Vere magnum, habere fragilitatem hominis, securitatem Dei*, we may with more sobriety and truth receive the rest of their inquiries and labours; wherein for the nature of good, positive or simple, they have set it down excellently, in describing the forms of virtue and duty with their situations and postures, in distributing them into their kinds, parts, provinces, actions, and administrations, and the like: nay farther they have commended them to man's nature and spirit, with great quickness of argument and beauty of persuasions; yea, and fortified and intrenched them, as much as discourse can do, against corrupt and popular opinions. Again, for the degrees and comparative nature of good, they have also excellently handled it in their triplicity of good, in the comparison between a contemplative and an active life, in the distinction between virtue with reluctation, and virtue secured, in their encounters between honesty and profit, in their balancing of virtue with virtue, and the like; so as this part deserveth to be reported for excellently laboured.

Notwithstanding, if before they had come to the popular and received notions of virtue and vice, pleasure and pain, and the rest, they had stayed a little longer upon the inquiry concerning the roots of good

and evil, and the strings of those roots, they had given, in my opinion, a great light to that which followed; and especially if they had consulted with nature, they had made their doctrines less prolix and more profound: which being by them in part omitted and in part handled with much confusion, we will endeavour to resume and open in a more clear manner.

There is formed in every thing a double nature of good, the one as every thing is a total or substantive in itself, the other as it is a part or member of a greater body; whereof the latter is in degree the greater and the worthier, because it tendeth to the conservation of a more general form: therefore we see the iron in particular sympathy moveth to the loadstone, but yet if it exceed a certain quantity, it forsaketh the affection to the loadstone, and like a good patriot moveth to the earth which is the region and country of massy bodies; so may we go forward and see that water and massy bodies move to the centre of the earth, but rather than to suffer a divulsion in the continuance of nature they will move upwards from the centre of the earth, forsaking their duty to the earth in regard of their duty to the world. This double nature of good and the comparative thereof is much more engraven upon man, if he degenerate not, unto whom the conservation of duty to the public ought to be much more precious than the conservation of life and being; according to that memorable speech of Pompeius Magnus, when being in commission of purveyance for a famine at Rome, and being dissuaded with great vehemency and instance by his friends about him, that he should not hazard himself to sea in an extremity of weather, he said only to them *Necesse est ut eam, non ut vivam:* but it may be truly affirmed that there was never any philosophy, religion, or other discipline, which did so plainly and highly exalt the good which is communicative, and depress the good which is private and particular, as the holy faith: well declaring, that it was the same God that gave the christian law to men, who gave those laws of nature to inanimate creatures that we spake of before; for we

read that the elected saints of God have wished themselves anathematized and razed out of the book of life, in an extasy of charity, and infinite feeling of communion.

This being set down and strongly planted, doth judge and determine most of the controversies wherein moral philosophy is conversant. For first, it decideth the question touching the preferment of the contemplative or active life, and decideth it against Aristotle: for all the reasons which he bringeth for the contemplative, are private, and respecting the pleasure and dignity of a man's self, in which respects, no question, the contemplative life hath the pre-eminence; not much unlike to that comparison, which Pythagoras made for the gracing and magnifying of philosophy and contemplation; who being asked what he was, answered, "That if Hiero were ever at the "Olympian games, he knew the manner, that some "came to try their fortune for the prizes, and some "came as merchants to utter their commodities, and "some came to make good cheer and meet their "friends, and some came to look on, and that he "was one of them that came to look on." But men must know, that in this theatre of man's life, it is reserved only for God and angels to be lookers on: neither could the like question ever have been received in the church, notwithstanding their *Pretiosa in oculis Domini mors sanctorum ejus;* by which place they would exalt their civil death and regular professions, but upon this defence, that the monastical life is not simply contemplative, but performeth the duty either of incessant prayers and supplications, which hath been truly esteemed as an office in the church, or else of writing or taking instructions for writing concerning the law of God; as Moses did when he abode so long in the mount. And so we see Enoch the seventh from Adam, who was the first contemplative, and walked with God; yet did also endow the church with prophecy, which St. Jude citeth. But for contemplation which should be finished in

itself, without casting beams upon society, assuredly divinity knoweth it not.

It decideth also the controversies between Zeno and Socrates, and their schools and successions on the one side, who placed felicity in virtue simply or attended; the actions and exercises whereof do chiefly embrace and concern society; and on the other side, the Cyreniacs and Epicureans, who placed it in pleasure, and made virtue, as it is used in some comedies of errors, wherein the mistress and the maid change habits, to be but as a servant, without which pleasure cannot be served and attended: and the reformed school of the Epicureans, which placed it in serenityof mind and freedom from perturbation; as if they would have deposed Jupiter again, and restored Saturn and the first age, when there was no summer nor winter, spring nor autumn, but all after one air and season; and Herillus, who placed felicity in extinguishment of the disputes of the mind, making no fixed nature of good and evil, esteeming things according to the clearness of the desires, or the reluctation; which opinion was revived in the heresy of the Anabaptists, measuring things according to the motions of the spirit, and the constancy or wavering of belief: all which are manifest to tend to private repose and contentment, and not to point of society.

It censureth also the philosophy of Epictetus, which presupposeth that felicity must be placed in those things which are in our power, lest we be liable to fortune and disturbance; as if it were not a thing much more happy to fail in good and virtuous ends for the public, than to obtain all that we can wish to ourselves in our proper fortune; as Consalvo said to his soldiers, shewing them Naples, and protesting, "He had rather die one foot forwards, than "to have his life secured for long, by one foot of re-"treat." Whereunto the wisdom of that heavenly leader hath signed, who hath affirmed *that a good conscience is a continual feast;* shewing plainly, that the conscience of good intentions, howsoever suc-

ceeding, is a more continual joy to nature, than all the provision which can be made for security and repose.

It censureth likewise that abuse of philosophy, which grew general about the time of Epictetus, in converting it into an occupation or profession; as if the purpose had been not to resist and extinguish perturbations, but to fly and avoid the causes of them, and to shape a particular kind and course of life to that end, introducing such an health of mind, as was that health of body, of which Aristotle speaketh of Herodicus, who did nothing all his life long but intend his health: whereas if men refer themselves to duties of society, as that health of body is best, which is ablest to endure all alterations and extremities; so likewise that health of mind is most proper, which can go through the greatest temptations and perturbations. So as Diogenes's opinion is to be accepted, who commended not them which abstained, but them which sustained, and could refrain their mind *in præcipitio*, and could give unto the mind, as is used in horsemanship, the shortest stop or turn.

Lastly, it censureth the tenderness and want of application in some of the most ancient and reverend philosophers and philosophical men, that did retire too easily from civil business, for avoiding of indignities and perturbations; whereas the resolution of men truly moral, ought to be such as the same Consalvo said the honor of a soldier should be, *è tela crassiore*, and not so fine, as that every thing should catch in it and endanger it.

To resume private or particular good, it falleth into the division of good active and passive: for this difference of good, not unlike to that which amongst the Romans was expressed in the familiar or houshold terms of *Promus* and *Condus*, is formed also in all things, and is best disclosed in the two several appetites in creatures; the one to preserve or continue themselves, and the other to dilate or multiply themselves; whereof the latter seemeth to be the worthier; for

in nature the heavens, which are more worthy, are the agent; and the earth, which is the less worthy, is the patient: in the pleasures of living creatures, that of generation is greater than that of food: in divine doctrine, *Beatius est dare, quam accipere:* and in life there is no man's spirit so soft, but esteemeth the effecting of somewhat that he hath fixed in his desire, more than sensuality. Which priority of the active good is much upheld by the consideration of our estate to be mortal and exposed to fortune: for if we might have a perpetuity and certainty in our pleasures, the state of them would advance their price; but when we see it is but *Magni æstimamus mori tardius*, and *Ne glorieris de crastino, nescis partum diei*, it maketh us to desire to have somewhat secured and exempted from time, which are only our deeds and works; as it is said *Opera eorum sequuntur eos.* The preeminence likewise of this active good is upheld by the affection which is natural in man towards variety and proceeding, which in the pleasures of the sense, which is the principal part of passive good, can have no great latitude. *Cogita quamdiu eadem feceris; cibus, somnus, ludus per hunc circulum curritur; mori velle non tantum fortis, aut miser, aut prudens, sed etiam fastidiosus potest.* But in enterprises, pursuits, and purposes of life, there is much variety, whereof men are sensible with pleasure in their inceptions, progressions, recoils, re-integrations, approaches and attainings to their ends. So as it was well said, *Vita sine proposito languida et vaga est.* Neither hath this active good any identity with the good of society, though in some case it hath an incidence into it: for although it do many times bring forth acts of beneficence, yet it is with a respect private to a man's own power, glory, amplification, continuance; as appeareth plainly, when it findeth a contrary subject. For that gigantine state of mind which possesseth the troublers of the world, such as was Lucius Sylla, and infinite other in smaller model, who would have all men happy or unhappy as they were their friends or enemies, and would give form

to the world according to their own humours, which is the true theomachy, pretendeth and aspireth to active good, though it recedeth farthest from good of society, which we have determined to be the greater.

To resume passive good, it receiveth a subdivision of conservative and perfective. For let us take a brief review of that which we have said; we have spoken first of the good of society, the intention whereof embraceth the form of human nature, whereof we are members and portions, and not our own proper and individual form; we have spoken of active good, and supposed it as a part of private and particular good. And rightly, for there is impressed upon all things a triple desire or appetite proceeding from love to themselves; one of preserving and continuing their form; another of advancing and perfecting their form; and a third of multiplying and extending their form upon other things; whereof the multiplying or signature of it upon other things, is that which we handled by the name of active good. So as there remaineth the conserving of it, and perfecting or raising of it; which latter is the highest degree of passive good. For to preserve in state is the less, to preserve with advancement is the greater. So in man,

Igneus est ollis vigor, et cælestis origo.

His approach or assumption to divine or angelical nature is the perfection of his form; the error or false imitation of which good, is that which is the tempest of human life, while man, upon the instinct of an advancement formal and essential, is carried to seek an advancement local. For as those which are sick, and find no remedy, do tumble up and down and change place, as if by a remove local they could obtain a remove internal: so is it with men in ambition, when failing of the means to exalt their nature, they are in a perpetual estuation to exalt their place. So then passive good is, as was said, either conservative or perfective.

To resume the good of conservation or comfort, which consisteth in the fruition of that which is agreeable to our natures; it seemeth to be the most pure

and natural of pleasures, but yet the softest and the lowest. And this also receiveth a difference, which hath neither been well judged of, nor well inquired. For the good of fruition or contentment, is placed either in the sincereness of the fruition, or in the quickness and vigour of it: the one superinduced by equality, the other by vicissitude; the one having less mixture of evil, the other more impression of good. Whether of these is the greater good, is a question controverted; but whether man's nature may not be capable of both, is a question not inquired.

The former question being debated between Socrates and a sophist, Socrates placing felicity in an equal and constant peace of mind, and the sophist in much desiring and much enjoying, they fell from argument to ill words: the sophist saying that Socrates's felicity was the felicity of a block or stone; and Socrates saying that the sophist's felicity was the felicity of one that had the itch, who did nothing but itch and scratch. And both these opinions do not want their supports: for the opinion of Socrates is much upheld by the general consent even of the Epicures themselves, that virtue beareth a great part in felicity: and if so, certain it is, that virtue hath more use in clearing perturbations, than in compassing desires. The sophist's opinion is much favoured by the assertion we last spake of, that good of advancement is greater than good of simple preservation; because every obtaining a desire hath a shew of advancement, as motion though in a circle hath a shew of progression.

But the second question decided the true way maketh the former superfluous: for can it be doubted but that there are some who take more pleasure in enjoying pleasures, than some other, and yet nevertheless are less troubled with the loss or leaving of them: so as this same, *Non uti, ut non appetas; non appetere, ut non metuas; sunt animi pusilli et diffidentis.* And it seemeth to me that most of the doctrines of the philosophers are more fearful and cautionary than the nature of things requireth: so have they increased

the fear of death in offering to cure it: for when they would have a man's whole life to be but a discipline or preparation to die, they must needs make men think that it is a terrible enemy against whom there is no end of preparing. Better saith the poet,

Qui finem vitæ extremum inter munera ponat
Naturæ:

So have they sought to make mens minds too uniform and harmonical, by not breaking them sufficiently to contrary motions: the reason whereof I suppose to be, because they themselves were men dedicated to a private, free, and unapplied course of life. For as we see, upon the lute or like instrument, a ground, though it be sweet and have shew of many changes, yet breaketh not the hand to such strange and hard stops and passages, as a set song or voluntary: much after the same manner was the diversity between a philosophical and a civil life. And therefore men are to imitate the wisdom of jewellers, who if there be a grain, or a cloud, or an ice which may be ground forth without taking too much of the stone, they help it; but if it should lessen and abate the stone too much, they will not meddle with it; so ought men so to procure serenity, as they destroy not magnanimity.

Having therefore deduced the good of man, which is private and particular, as far as seemeth fit, we will now return to that good of man which respecteth and beholdeth Society, which we may term duty; because the term of duty is more proper to a mind well framed and disposed towards others, as the term of virtue is applied to a mind well formed and composed in itself; though neither can a man understand virtue without some relation to society, nor duty without an inward disposition. This part may seem at first to pertain to science civil and politic, but not if it be well observed; for it concerneth the regimen and government of every man over himself, and not over others. And as in architecture the direction of the framing the posts, beams, and other parts of building, is not the same with the manner of joining them and erecting the building; and in mechanics, the direction

how to frame an instrument or engine, is not the same with the manner of setting it on work and employing it; and yet nevertheless in expressing of the one you incidently express the aptness towards the other: so the doctrine of conjugation of men in society differeth from that of their conformity thereunto.

This part of duty is subdivided into two parts; the common duty of every man as a man or member of a state, the other the respective or special duty of every man in his profession, vocation, and place. The first of these is extant and well laboured, as hath been said. The second likewise I may report rather dispersed, than deficient; which manner of dispersed writing in this kind of argument I acknowledge to be best: for who can take upon him to write of the proper duty, virtue, challenge, and right of every several vocation, profession, and place? For although sometimes a looker on may see more than a gamester, and there be a proverb more arrogant than sound, "That the vale best discovereth the hill;" yet there is small doubt but that men can write best, and most really and materially in their own professions; and that the writing of speculative men of active matter, for the most part, doth seem to men, of experience, as Phormio's argument of the wars seemed to Hannibal, to be but dreams and dotage. Only there is one vice which accompanieth them that write in their own professions, that they magnify them in excess; but generally it were to be wished, as that which would make learning indeed solid and fruitful, that active men would or could become writers.

In which I cannot but mention, *honoris causa*, your majesty's excellent book touching the duty of a king, a work richly compounded of divinity, morality, and policy, with great aspersion of all other arts; and being in mine opinion one of the most sound and healthful writings that I have read, not distempered in the heat of invention, nor in the coldness of negligence; not sick of business, as those are who lose themselves in their order, nor of convulsions, as those which cramp in matters impertinent; not savouring

of perfumes and paintings, as those do who seek to please the reader more than nature beareth; and chiefly well disposed in the spirits thereof, being agreeable to truth and apt for action, and far removed from that natural infirmity whereunto I noted those that write in their own professions to be subject, which is, that they exalt it above measure. for your majesty hath truly described, not a king of Assyria, or Persia, in their external glory, but a Moses, or a David, pastors of their people. Neither can I ever lose out of my remembrance, what I heard your majesty in the same sacred spirit of government deliver in a great cause of judicature, which was, "That kings ruled by their laws as God did by the "laws of nature, and ought as rarely to put in use "their supreme prerogative, as God doth his power "of working miracles." And yet notwithstanding, in your book of a free monarchy, you do well give men to understand, that you know the plenitude of the power and right of a king, as well as the circle of his office and duty. Thus have I presumed to alledge this excellent writing of your majesty, as a prime or eminent example of Tractates concerning special and respective duties, wherein I should have said as much if it had been written a thousand years since: neither am I moved with certain courtly decencies, which esteem it flattery to praise in presence; no, it is flattery to praise in absence, that is, when either the virtue is absent, or the occasion is absent, and so the praise is not natural but forced, either in truth or in time. But let Cicero be read in his oration *pro Marcello*, which is nothing but an excellent table of Cæsar's virtue, and made to his face; besides the example of many other excellent persons wiser a great deal than such observers, and we will never doubt, upon a full occasion, to give just praises to present or absent.

But to return, there belongeth farther to the handling of this part, touching the duties of professions and vocations, a relative or opposite touching the frauds, cautels, impostures, and vices of every pro-

fession, which hath been likewise handled. But how? Rather in a satire and cynically, than seriously and wisely; for men have rather sought by wit to deride and traduce much of that which is good in professions, than with judgment to discover and sever that which is corrupt. For, as Solomon saith, he that cometh to seek after knowledge with a mind to scorn and censure, shall be sure to find matter for his humour, but no matter for his instruction: *Quærenti derisori scientiam, ipsa se abscondit: sed studiosa fit obviam.* But the managing of this argument with integrity and truth, which I note as deficient, seemeth to me to be one of the best fortifications for honesty and virtue that can be planted. For, as the fable goeth of the basilisk, that if he see you first, you die for it; but if you see him first, he dieth: so is it with deceits and evil arts, which, if they be first espied, lose their life; but if they prevent, they indanger. So that we are much beholden to Machiavel and others, that write what men do, and not what they ought to do: for it is not possible to join serpentine wisdom with the columbine innocency, except men know exactly all the conditions of the serpent; his baseness and going upon his belly, his volubility and lubricity, his envy and sting, and the rest; that is, all forms and natures of evil: for without this, virtue lieth open and unfenced. Nay, an honest man can do no good upon those that are wicked, to reclaim them, without the help of the knowledge of evil: for men of corrupted minds presuppose that honesty groweth out of simplicity of manners, and believing of preachers, schoolmasters and mens exterior language. So as, except you can make them perceive that you know the utmost reaches of their own corrupt opinions, they despise all morality; *Non recipit stultus verba prudentiæ, nisi ea dixeris, quæ versantur in corde ejus.*

De cautelis et malis artibus.

Unto this part touching respective duty doth also appertain the duties between husband and wife, parent and child, master and servant: so likewise the laws of friendship and gratitude, the civil bond of

companies, colleges and politic bodies, of neighbourhood, and all other proportionate duties; not as they are parts of government and society, but as to the framing of the mind of particular persons.

The knowledge concerning good respecting society doth handle it also not simply alone, but comparatively, whereunto belongeth the weighing of duties between person and person, case and case, particular and public: as we see in the proceeding of Lucius Brutus against his own sons, which was so much extolled; yet what was said?

Infelix, utcunque ferent ea fata minores.

So the case was doubtful, and had opinion on both sides. Again, we see when M. Brutus and Cassius invited to a supper certain whose opinions they meant to feel, whether they were fit to be made their associates, and cast forth the question touching the killing of a tyrant being an usurper, they were divided in opinion, some holding that servitude was the extreme of evils, and others that tyranny was better than a civil war; and a number of the like cases there are of comparative duty: amongst which that of all others is the most frequent, where the question is of a great deal of good to ensue of a small injustice, which Jason of Thessalia determined against the truth: *Aliqua sunt injuste facienda, ut multa juste fieri possint.* But the reply is good, *Auctorem præsentis justitiæ habes, sponsorem futuræ non habes*; men must pursue things which are just in present, and leave the future to the divine providence. So then we pass on from this general part touching the exemplar and description of good.

Now therefore that we have spoken of this fruit of life, it remaineth to speak of the husbandry that belongeth thereunto, without which part the former seemeth to be no better than a fair image, or *statua*, which is beautiful to contemplate, but is without life and motion: whereunto Aristotle himself subscribeth in these words, *Necesse est scilicet de virtute dicere, et quid sit, et ex quibus gignatur. Inutile enim fere fuerit, virtutem quidem nosse, acquirendæ autem* De cultura animi.

ejus modos et vias ignorare : non enim de virtute tantum, qua specie sit, quærendum est, sed et quomodo sui copiam faciat ; utrumque enim volumus, et rem ipsam nosse et ejus compotes fieri : hoc autem ex voto non succedet, nisi sciamus et ex quibus et quomodo. In such full words and with such iteration doth he inculcate this part; so saith Cicero in great commendation of Cato the second, that he had applied himself to philosophy, *non ita disputandi causa, sed ita vivendi.* And although the neglect of our times, wherein few men do hold any consultations touching the reformation of their life, as Seneca excellently saith, *De partibus vitæ quisque deliberat, de summa nemo*, may make this part seem superfluous; yet I must conclude with that aphorism of Hippocrates, *Qui gravi morbo correpti dolores non sentiunt, iis mens ægrotat ;* they need medicine not only to assuage the disease, but to awake the sense. And if it be said, that the cure of mens minds belongeth to sacred divinity, it is most true: but yet moral philosophy may be preferred unto her as a wise servant and humble handmaid. For as the Psalm saith, that *the eyes of the handmaid look perpetually towards the mistress*, and yet no doubt many things are left to the discretion of the handmaid, to discern of the mistress's will; so ought moral philosophy to give a constant attention to the doctrines of divinity, and yet so as it may yield of herself, within due limits, many sound and profitable directions.

This part therefore, because of the excellency thereof, I cannot but find exceeding strange that it is not reduced to written inquiry, the rather because it consisteth of much matter, wherein both speech and action is often conversant, and such wherein the common talk of men, which is rare, but yet cometh sometimes to pass, is wiser than their books. It is reasonable therefore that we propound it in the more particularity, both for the worthiness, and because we may acquit ourselves for reporting it deficient, which seemeth almost incredible, and is otherwise conceived and presupposed by those themselves

that have written. We will therefore enumerate some heads or points thereof, that it may appear the better what it is, and whether it be extant.

First, therefore, in this, as in all things which are practical, we ought to cast up our account, what is in our power, and what not; for the one may be dealt with by way of alteration, but the other by way of application only. The husbandman cannot command, neither the nature of the earth, nor the seasons of the weather, no more can the physician the constitution of the patient, nor the variety of accidents. So in the culture and cure of the mind of man, two things are without our command; points of nature, and points of fortune: for to the basis of the one, and the conditions of the other, our work is limited and tied. In these things therefore, it is left unto us to proceed by application.

Vincenda est omnis fortuna ferendo:

and so likewise,

Vincenda est omnis natura ferendo.

But when that we speak of suffering, we do not speak of a dull and neglected suffering, but of a wise and industrious suffering, which draweth and contriveth use and advantage out of that which seemeth adverse and contrary, which is that properly which we call accommodating or applying. Now the wisdom of application resteth principally in the exact and distinct knowledge of the precedent state or disposition, unto which we do apply; for we cannot fit a garment, except we first take measure of the body.

So then the first article of this knowledge is to set down sound and true distributions, and descriptions of the several characters and tempers of mens natures and dispositions, especially having regard to those differences which are most radical, in being the fountains and causes of the rest, or most frequent in concurrence or commixture; wherein it is not the handling of a few of them in passage, the better to describe the mediocrities of virtues, that can satisfy this intention: for if it deserve to be considered, "that there are minds which are proportioned to great mat-

ters, and others to small," which Aristotle handleth or ought to have handled by the name of magnanimity, doth it not deserve as well to be considered, " that there are minds proportioned to intend many " matters, and others to few?" So that some can divide themselves, others can perchance do exactly well, but it must be but in few things at once; and so there cometh to be a narrowness of mind, as well as a pusillanimity. And again, " that some minds " are proportioned to that which may be dispatched " at once, or within a short return of time; others to " that which begins afar off, and is to be won with " length of pursuit,"

Jam tum tenditque fovetque.

So that there may be fitly said to be a longanimity, which is commonly ascribed to God as a magnanimity. So farther deserved it to be considered by Aristotle, " that there is a disposition in conversation, " supposing it in things which do in no sort touch " or concern a man's self, to sooth and please; and " a disposition contrary to contradict and cross:" and deserveth it not much better to be considered, " that " there is a disposition, not in conversation or talk, but " in matter of more serious nature, and supposing it " still in things merely indifferent, to take pleasure " in the good of another, and a disposition contra- " riwise, to take distaste at the good of another?" which is that properly which we call good-nature or ill-nature, benignity or malignity. And therefore I cannot sufficiently marvel, that this part of knowledge, touching the several characters of natures and dispositions, should be omitted both in morality and policy, considering it is of so great ministry and suppeditation to them both. A man shall find in the traditions of astrology some pretty and apt divisions of mens natures, according to the predominances of the planets; lovers of quiet, lovers of action, lovers of victory, lovers of honour, lovers of pleasure, lovers of arts, lovers of change, and so forth. A man shall find in the wisest sort of these relations, which the Italians make touching conclaves, the natures of the several

cardinals handsomely and lively painted forth; a man shall meet with, in every day's conference, the denominations of sensitive, dry, formal, real, humourous, certain, *huomo di prima impressione*, *huomo di ultima impressione*, and the like: and yet nevertheless this kind of observations wandereth in words, but is not fixed in inquiry. For the distinctions are found, many of them, but we conclude no precepts upon them: wherein our fault is the greater, because both history, poesy, and daily experience are as goodly fields where these observations grow; whereof we make a few poesies to hold in our hands, but no man bringeth them to the confectionary, that receipts might be made of them for the use of life.

Of much like kind are those impressions of nature, which are imposed upon the mind by the sex, by the age, by the region, by health and sickness, by beauty and deformity, and the like, which are inherent, and not external; and again, those which are caused by external fortune: as sovereignty, nobility, obscure birth, riches, want, magistracy, privateness, prosperity, adversity, constant fortune, variable fortune, rising *per saltum*, *per gradus*, and the like. And therefore we see that Plautus maketh it a wonder to see an old man beneficent, *benignitas hujus ut adolescentuli est.* St. Paul concludeth, that severity of discipline was to be used to the Cretans, *Increpa eos dure*, upon the disposition of their country, *Cretenses semper mendaces, malæ bestiæ, ventres pigri.* Sallust noteth, that it is usual with kings to desire contradictories; *Sed plerumque regiæ voluntates, ut vehementes sunt, sic mobiles, sæpeque ipsæ sibi adversæ.* Tacitus observeth how rarely raising of the fortune mendeth the disposition, *Solus Vespasianus mutatus in melius.* Pindarus maketh an observation, that great and sudden fortune for the most part defeateth men, *Qui magnam felicitatem concoquere non possunt.* So the *Psalm* sheweth it is more easy to keep a measure in the enjoying of fortune, than in the increase of fortune: *Divitæ si affluant, nolite cor apponere.* These observations, and the like, I deny not but are touched

a little by Aristotle, as in passage, in his Rhetorics, and are handled in some scattered discourses; but they were never incorporated into moral philosophy, to which they do essentially appertain; as the knowledge of the diversity of grounds and moulds doth to agriculture, and the knowledge of the diversity of complexions and constitutions doth to the physician; except we mean to follow the indiscretion of empirics, which administer the same medicines to all patients.

Another article of this knowledge, is the inquiry touching the affections: for as in medicining of the body, it is in order first to know the divers complexions and constitutions; secondly, the diseases; and lastly, the cures: so in medicining of the mind, after knowledge of the divers characters of mens natures, it followeth, in order, to know the diseases and infirmities of the mind, which are no other than the perturbations and distempers of the affections. For as the ancient politicians in popular states were wont to compare the people to the sea, and the orators to the winds, because as the sea would of itself be calm and quiet, if the winds did not move and trouble it; so the people would be peaceable and tractable if the seditious orators did not set them in working and agitation: so it may be fitly said, that the mind in the nature thereof would be temperate and stayed, if the affections, as winds, did not put it into tumult and perturbation. And here again I find strange as before, that Aristotle should have written divers volumes of Ethics, and never handled the affections, which is the principal subject thereof; and yet in his Rhetorics, where they are considered but collaterally, and in a second degree, as they may be moved by speech, he findeth place for them, and handleth them well for the quantity; but where their true place is, he pretermiteth them. For it is not his disputations about pleasure and pain that can satisfy this inquiry, no more than he that should generally handle the nature of light, can be said to handle the nature of colours; for pleasure and pain are to the particu-

lar affections, as light is to particular colours. Better travels, I suppose, had the Stoics taken in this argument, as far as I can gather by that which we have at second hand. But yet, it is like, it was after their manner, rather in subtilty of definitions, which, in a subject of this nature, are but curiosities, than in active and ample descriptions and observations. So likewise I find some particular writings of an elegant nature, touching some of the affections; as of anger, of comfort upon adverse accidents, of tenderness of countenance, and other. But the poets and writers of histories are the best doctors of this knowledge, where we may find painted forth with great life, how affections are kindled and incited; and how pacified and refrained; and how again contained from act, and farther degree; how they disclose themselves; how they work; how they vary; how they gather and fortify; how they are inwrapped one within another; and how they do fight and encounter one with another; and other the like particularities. Amongst the which, this last is of special use in moral and civil matters: how, I say, to set affection against affection, and to master one by another, even as we use to hunt beast with beast, and fly bird with bird, which otherwise perhaps we could not so easily recover: upon which foundation is erected that excellent use of *præmium* and *pœna*, whereby civil states consist, employing the predominant affections of fear and hope, for the suppressing and bridling the rest. For as in the government of states, it is sometimes necessary to bridle one faction with another, so it is in the government within.

Now come we to those points which are within our own command, and have force and operation upon the mind, to affect the will and appetite, and to alter manners: wherein they ought to have handled custom, exercise, habit, education, example, imitation, emulation, company, friends, praise, reproof, exhortation, fame, laws, books, studies: these as they have determinate use in moralities, from these the mind suffereth, and of these are such receipts and regimens

compounded and described, as may serve to recover or preserve the health and good estate of the mind, as far as pertaineth to human medicine; of which number we will insist upon some one or two, as an example of the rest, because it were too long to prosecute all; and therefore we do resume custom and habit to speak of.

The opinion of Aristotle seemeth to me a negligent opinion, that of those things which consist by nature, nothing can be changed by custom; using for example, that if a stone be thrown ten thousand times up, it will not learn to ascend, and that by often seeing or hearing, we do not learn to hear or see the better. For though this principle be true in things wherein nature is peremptory, the reason whereof we cannot now stand to discuss, yet it is otherwise in things wherein nature admitteth a latitude. For he might see that a strait glove will come more easily on with use; and that a wand will by use bend otherwise than it grew; and that by use of the voice we speak louder and stronger; and that by use of enduring heat or cold, we endure it the better, and the like: which latter sort have a nearer resemblance unto that subject of manners he handleth, than those instances which he alledgeth. But allowing his conclusion, that virtues and vices consist in habit, he ought so much the more to have taught the manner of superinducing that habit: for there be many precepts of the wise ordering the exercises of the mind, as there is of ordering the exercises of the body, whereof we will recite a few.

The first shall be, that we beware we take not at the first either too high a strain, or too weak: for if too high in a diffident nature you discourage; in a confident nature you breed an opinion of facility, and so a sloth: and in all natures you breed a farther expectation than can hold out, and so an insatisfaction in the end: if too weak of the other side, you may not look to perform and overcome any great task.

Another precept is, to practise all things chiefly at two several times, the one when the mind is best

disposed, the other when it is worst disposed; that by the one you may gain a great step, by the other you may work out the knots and stones of the mind, and make the middle times the more easy and pleasant.

Another precept is that which Aristotle mentioneth by the way, which is, to bear ever towards the contrary extreme of that whereunto we are by nature inclined: like unto the rowing against the stream, or making a wand straight, by binding him contrary to his natural crookedness.

Another precept is, that the mind is brought to any thing better, and with more sweetness and happiness, if that whereunto you pretend be not first in the intention, but *tanquam aliud agendo*, because of the natural hatred of the mind against necessity and constraint. Many other axioms there are touching the managing of exercise and custom; which being so conducted, doth prove indeed another nature; but being governed by chance, doth commonly prove but an ape of nature, and bringeth forth that which is lame and counterfeit.

So if we should handle books and studies, and what influence and operation they have upon manners, are there not divers precepts of great caution and direction appertaining thereunto? Did not one of the fathers in great indignation call poesy *vinum dæmonum*, because it increaseth temptations, perturbations, and vain opinions? Is not the opinion of Aristotle worthy to be regarded, wherein he saith, "That young men are no fit auditors of moral phi-"losophy, because they are not settled from the "boiling heat of their affections, nor attempered with "time and experience?" And doth it not hereof come, that those excellent books and discourses of the ancient writers, whereby they have persuaded unto virtue most effectually, by representing her in state and majesty; and popular opinions against virtue in their parasites coats, fit to be scorned and derided, are of so little effect towards honesty of life, because they are not read, and revolved by men in

their nature and settled years, but confined almost to boys and beginners? But is it not true also, that much less young men are fit auditors of matters of policy, till they have been thoroughly seasoned in religion and morality, lest their judgments be corrupted, and made apt to think that there are no true differences of things, but according to utility and fortune, as the verse describes it?

Prosperum et felix scelus virtus vocatur.

And again,

Ille crucem pretium sceleris tulit, hic diadema:

which the poets do speak satirically, and in indignation on virtue's behalf: but books of policy do speak it seriously and positively; for it so pleaseth Machiavel to say, "that if Cæsar had been overthrown, he would "have been more odious than ever was Catiline:" as if there had been no difference, but in fortune, between a very fury of lust and blood, and the most excellent spirit, his ambition reserved, of the world? Again, is there not a caution likewise to be given of the doctrines of moralities themselves, some kinds of them, less they make men too precise, arrogant, incompatible, as Cicero saith of Cato in *Marco Catone: Hæc bona, quæ videmus, divina et egregia, ipsius scitote esse propria: quæ nonnunquam requirimus, ea sunt omnia, non à natura, sed à magistro?* Many other axioms and advices there are touching those proprieties and effects, which studies do infuse and instil into manners. And so likewise is there touching the use of all those other points, of company, fame, laws, and the rest, which we recited in the beginning in the doctrine of morality.

But there is a kind of culture of the mind that seemeth yet more accurate and elaborate than the rest, and is built upon this ground: that the minds of all men are sometimes in a state more perfect, and at other times in a state more depraved. The purpose therefore of this practice is, to fix and cherish the good hours of the mind, and to obliterate and take forth the evil. The fixing of the good hath been practised by two means, vows or constant resolutions,

and observances or exercises; which are not to be regarded so much in themselves, as because they keep the mind in continual obedience. The obliteration of the evil hath been practised by two means, some kind of redemption or expiation of that which is past, and an inception or account *de novo*, for the time to come: but this part seemeth sacred and religious, and justly; for all good moral philosophy, as was said, is but an handmaid to religion.

Wherefore we will conclude with that last point, which is of all other means the most compendious and summary; and, again, the most noble and effectual to the reducing of the mind unto virtue and good estate; which is, the electing and propounding unto a man's self good and virtuous ends of his life, such as may be in a reasonable sort within his compass to attain. For if these two things be supposed, that a man set before him honest and good ends, and again that he be resolute, constant, and true unto them; it will follow, that he shall mould himself into all virtue at once. And this is indeed like the work of nature, whereas the other course is like the work of the hand: for as when a carver makes an image, he shapes only that part whereupon he worketh, as if he be upon the face, that part which shall be the body is but a rude stone still, till such time as he comes to it: but, contrariwise, when nature makes a flower or living creature, she formeth rudiments of all the parts at one time: so in obtaining virtue by habit, while a man practiseth temperance, he doth not profit much to fortitude, nor the like: but when he dedicateth and applieth himself to good ends, look, what virtue soever the pursuit and passage towards those ends doth commend unto him, he is invested of a precedent disposition to conform himself thereunto. Which state of mind Aristotle doth excellently express himself, that it ought not to be called virtuous but divine: his words are these; *Immanitati autem consentaneum est, opponere eam, quæ supra humanitatem est, heroicam sive divinam virtutem.* And a little after, *Nam ut feræ neque vitium neque*

virtus est, sic neque Dei. Sed hic quidem status altius quiddam virtute est, ille aliud quiddam à vitio. And therefore we may see what celsitude of honour Plinius Secundus attributeth to Trajan in his funeral oration; where he said, "that men needed to make no "other prayers to the gods, but that they would con- "tinue as good lords to them as Trajan had been;" as if he had not been only an imitation of divine nature, but a pattern of it. But these be heathen and profane passages, having but a shadow of that divine state of mind, which religion and the holy faith doth conduct men unto, by imprinting upon their souls charity, which is excellently called *the bond of perfection*, because it comprehendeth and fasteneth all virtues together. And as it is elegantly said by Menander of vain love, which is but a false imitation of divine love, *Amor melior sophista lævo ad humanam vitam*, that love teacheth a man to carry himself better than the sophist or preceptor, which he calleth left-handed, because, with all his rules and precepts, he cannot form a man so dexterously, nor with that facility, to prize himself, and govern himself, as love can do. So certainly if a man's mind be truly inflamed with charity, it doth work him suddenly into greater perfection than all the doctrine of morality can do, which is but a sophist in comparison of the other. Nay farther, as Xenophon observed truly, that all other affections, though they raise the mind, yet they do it by distorting and uncomeliness of ecstasies or excesses; but only love doth exalt the mind, and nevertheless at the same instant doth settle and compose it: so in all other excellencies, though they advance nature, yet they are subject to excess. Only charity admitteth no excess; for so we see, by aspiring to be like God in power, the angels transgressed and fell; *Ascendam, et ero similis Altissimo*: by aspiring to be like God in knowledge, man transgressed and fell; *Eritis sicut Dii, scientes bonum et malum:* but by aspiring to a similitude of God in goodness, or love, neither man nor angel ever transgressed, or shall transgress. For unto that

imitation we are called; *Diligite inimicos vestros, benefacite eis qui oderunt vos, et orate pro persequentibus et calumniantibus vos ut sitis filii Patris vestri, qui in cœlis est, qui solem suum oriri facit super bonos et malos, et pluit super justos et injustos.* So in the first platform of the divine nature itself, the heathen religion speaketh thus, *Optimus Maximus;* and the sacred Scriptures thus, *Misericordia ejus super omnia opera ejus.*

Wherefore I do conclude this part of moral knowledge concerning the culture and regimen of the mind; wherein if any man, considering the parts thereof, which I have enumerated, do judge that my labour is but to collect into an art or science, that which hath been pretermitted by others, as matters of common sense and experience, he judgeth well: but as Philocrates sported with Demosthenes, "You "may not marvel, Athenians, that Demosthenes "and I do differ, for he drinketh water, and I "drink wine." And like as we read of an ancient parable of the two gates of sleep,

Sunt geminæ somni portæ, quarum altera fertur
Cornea, qua veris facilis datur exitus umbris:
Altera candenti perfecta nitens elephanto,
Sed falsa ad cœlum mittunt insomnia manes.

So if we put on sobriety and attention, we shall find it a sure maxim in knowledge, that the more pleasant liquor of wine is the more vaporous, and the braver gate of ivory sendeth forth the falser dreams.

But we have now concluded that general part of human philosophy, which contemplateth man segregate, and as he consisteth of body and spirit. Wherein we may farther note, that there seemeth to be a relation or conformity between the good of the mind and the good of the body. For as we divided the good of the body into health, beauty, strength, and pleasure; so the good of the mind, inquired in rational and moral knowledges, tendeth to this, to make the mind sound and without perturbation, beautiful and graced with decency; and strong and agile for all

duties of life. These three, as in the body, so in the mind, seldom meet, and commonly sever. For it is easy to observe, that many have strength of wit and courage, but have neither health from perturbations, nor any beauty or decency in their doings: some again have an elegancy and fineness of carriage, which have neither soundness of honesty, nor substance of sufficiency: and some again have honest and reformed minds, that can neither become themselves, nor manage business. And sometimes two of them meet, and rarely all three. As for pleasure, we have likewise determined, that the mind ought not to be reduced to stupidity, but to retain pleasure; confined rather in the subject of it, than in the strength and vigour of it.

Civil Knowledge is conversant about a subject which of all others is most immersed in matter, and hardliest reduced to axiom. Nevertheless, as Cato the censor said, "that the Romans were like sheep, "for that a man might better drive a flock of them, "than one of them; for in a flock, if you could get "but some few to go right, the rest would follow:" so in that respect moral philosophy is more difficult than policy. Again, moral philosophy propoundeth to itself the framing of internal goodness; but civil knowledge requireth only an external goodness; for that as to society sufficeth. And therefore it cometh oft to pass that there be evil times in good governments: for so we find in the holy story, when the kings were good; yet it is added, *Sed adhuc populus non direxerat cor suum ad Dominum Deum patrum suorum.* Again, states, as great engines, move showly, and are not so soon put out of frame: for as in Egypt the seven good years sustained the seven bad; so governments for a time well grounded, do bear out errors following. But the resolution of particular persons is more suddenly subverted. These respects do somewhat qualify the extreme difficulty of civil knowledge.

This knowledge hath three parts according to the three summary actions of society, which are Conver-

sation, Negotiation, and Government. For man seeketh in society comfort, use, and protection: and and they be three wisdoms of divers natures, which do often sever; wisdom of behaviour, wisdom of business, and wisdom of state.

The wisdom of Conversation ought not to be over much affected, but much less despised: for it hath not only an honor in itself, but an influence also into business and government. The poet saith, *Nec vultu destrue verba tuo.* A man may destroy the force of his words with his countenance: so may he of his deeds, saith Cicero, recommending to his brother affability and easy access, *Nil interest habere ostium apertum, vultum clausum.* "It is nothing won to "admit men with an open door, and to receive them "with a shut and reserved countenance." So, we see, Atticus, before the first interview between Cæsar and Cicero, the war depending, did seriously advise Cicero touching the composing and ordering of his countenance and gesture. And if the government of the countenance be of such effect, much more is that of the speech, and other carriage appertaining to conversation; the true model whereof seemeth to me well expressed by Livy, though not meant for this purpose; *Ne aut arrogans videar, aut obnoxius; quorum alterum est alienæ libertatis obliti, alterum suæ:* "The sum of behaviour is to retain a man's own dig-"nity, without intruding upon the liberty of others." On the other side, if behaviour and outward carriage be intended too much, first it may pass into affectation, and then *Quid deformius, quam scenam in vitam transferre,* to act a man's life? But although it proceed not to that extreme, yet it consumeth time, and employeth the mind too much. And therefore as we use to advise young students from company keeping, by saying, *Amici, fures temporis*; so certainly the intending of the discretion of behaviour is a great thief of meditation. Again, such as are accomplished in that form of urbanity, please themselves in it, and seldom aspire to higher virtue; whereas those that have defect in it, do seek comeliness by re-

putation; for where reputation is, almost every thing becometh; but where that is not, it must be supplied by punctilios and compliments. Again, there is no greater impediment of action, than an over-curious observance of decency, and the guide of decency, which is time and season. For as Solomon saith, *Qui respicit ad ventos, non seminat; et qui respicit ad nubes, non metet:* a man must make his opportunity as oft as find it. To conclude; behaviour seemeth to me as a garment of the mind, and to have the conditions of a garment. For it ought to be made in fashion; it ought not to be too curious, it ought to be shaped so as to set forth any good making of the mind, and hide any deformity; and above all, it ought not to be too strait, or restrained for exercise or motion. But this part of civil knowledge hath been elegantly handled, and therefore I cannot report it for deficient.

De negotiis gerendis.

The wisdom touching Negotiation or Business hath not been hitherto collected into writing, to the great derogation of learning, and the professors of learning. For from this root springeth chiefly that note or opinion, which by us is expressed in adage to this effect; that there is no great concurrence between learning and wisdom. For of the three wisdoms which we have set down to pertain to civil life, for wisdom of behaviour, it is by learned men for the most part despised, as an inferior to virtue, and an enemy to meditation; for wisdom of government, they acquit themselves well when they are called to it, but that happeneth to few: but for the wisdom of business, wherein man's life is most conversant, there be no books of it, except some few scattered advertisements, that have no proportion to the magnitude of this subject. For if books were written of this, as the other, I doubt not but learned men, with mean experience, would far excel men of long experience, without learning, and outshoot them in their own bow.

Neither needeth it at all to be doubted, that this knowledge should be so variable, as it falleth not

under precept; for it is much less infinite than science of government, which, we see, in laboured, and in some part reduced. Of this wisdom, it seemeth, some of the ancient Romans, in the sagest and wisest times, were professors; for Cicero reporteth, that it was then in use for senators that had name and opinion for general wise men, as Coruncanius, Curius, Lælius, and many others, to walk at certain hours in the place, and to give audience to those that would use their advice; and that the particular citizens would resort unto them, and consult with them of the marriage of a daughter, or of the employing of a son, or of a purchase or bargain, or of an accusation, and every other occasion incident to man's life. So as there is a wisdom of counsel and advice even in private cases, arising out of an universal insight into the affairs of the world; which is used indeed upon particular cases propounded, but is gathered by general observation of cases of like nature. For so we see in the book which Q. Cicero writeth to his brother, *De petitione consulatus*, being the only book of business, that I know, written by the ancients, although it concerned a particular action then on foot, yet the substance thereof consisteth of many wise and politic axioms, which contain not a temporary, but a perpetual direction in the case of popular elections. But chiefly we may see in those aphorisms which have place amongst divine writings, composed by Solomon the king, of whom the scriptures testify, that his heart was as the sands of the sea, encompassing the world and all worldly matters: we see, I say, not a few profound and excellent cautions, precepts, positions, extending to much variety of occasions; whereupon we will stay awhile, offering to consideration some number of examples.

Sed et cunctis sermonibus, qui dicuntur, ne accommodes aurem tuam, ne forte audias servum tuum maledicentem tibi.

Here is recommended the provident stay of inquiry of that which we would be loth to find: as it was

judged great wisdom in Pompeius Magnus that he burned Sertorius's papers unperused.

Vir sapiens, si cum stulto contenderit, sive irascatur, sive rideat, non inveniet requiem.

Here is described the great disadvantage which a wise man hath in undertaking a lighter person than himself, which is such an engagement, as whether a man turn the matter to jest, or turn it to heat, or howsoever he change copy, he can no ways quit himself well of it.

Qui delicate à pueritia nutrit servum suum, postea sentiet eum contumacem.

Here is signified, that if a man begin too high a pitch in his favours, it doth commonly end in unkindness and unthankfulness.

Vidisti virum velocem in opere suo, coram regibus stabit, nec erit inter ignobiles.

Here is observed, that of all virtues for rising to honour, quickness of dispatch is the best; for superiors many times love not to have those they employ, too deep or too sufficient, but ready and diligent.

Vidi cunctos viventes, qui ambulant sub sole, cum adolescente secundo, qui consurgit pro eo.

Here is expressed that which was noted by Sylla first, and after him by Tiberius; *Plures adorant solem orientem, quam occidentem vel meridianum.*

Si spiritus potestatem habentis ascenderit super te, locum tuum ne dimiseris, quia curatio faciet cessare peccata maxima.

Here caution is given, that upon displeasure, retiring is of all courses the unfittest; for a man leaveth things at worst, and depriveth himself of means to make them better.

Erat civitas parva, et pauci in ea viri; venit contra eam rex magnus, et vadavit eam, instruxitque munitiones per gyrum, et perfecta est obsidio; inventusque est in ea vir pauper et sapiens, et liberavit eam per sapientiam suam, et nullus deinceps recordatus est hominis illius pauperis.

Here the corruption of states is set forth, that esteem not virtue or merit longer than they have use of it.

Mollis responsio frangit iram.

Here is noted, that silence or rough answer exasperateth; but an answer present and temperate pacifieth.

Iter pigrorum, quasi sepes spinarum.

Here is lively represented how laborious sloth proveth in the end; for when things are deferred to the last instant, and nothing prepared beforehand, every step findeth a brier or an impediment, which catcheth or stoppeth.

Melior est finis orationis, quam principium.

Here is taxed the vanity of formal speakers, that study more about prefaces and inducements, than upon the conclusions and issues of speech.

Qui cognoscit in judicio faciem, non bene facit; iste et pro buccella panis deseret veritatem.

Here is noted, that a judge were better be a briber, than a respecter of persons; for a corrupt judge offendeth not so lightly as a facile.

Vir pauper calumnians pauperes, similis est imbri vehementi, in quo paratur fames.

Here is expressed the extremity of necessitous extortions, figured in the ancient fable of the full and the hungry horse-leech.

Fons turbatus pede, et vena corrupta, est justus cadens coram impio.

Here is noted that one judicial and exemplar iniquity in the face of the world, doth trouble the fountains of justice more than many particular injuries passed over by connivance.

Qui subtrahit aliquid à patre et à matre, et dicit hoc non esse peccatum, particeps est homicidii.

Here is noted, that whereas men in wronging their best friends, use to extenuate their fault, as if they might presume or be bold upon them, it doth contrariwise indeed aggravate their fault, and turneth it from injury to impiety.

Noli esse amicus homini iracundo, nec ambulato cum homine furioso.

Here caution is given, that in the election of our friends we do principally avoid those which are im-

patient, as those that will espouse us to many factions and quarrels.

Qui conturbat domum suam, possidebit ventum.

Here is noted that in domestical separations and breaches men do promise to themselves quieting of their mind and contentment, but still they are deceived of their expectation, and it turneth to wind.

Filius sapiens lætificat patrem: filius vero stultus mœstitia es matri suæ.

Here is distinguished, that fathers have most comfort of the good proof of their sons; but mothers have most discomfort of their ill proof, because women have little discerning of virtue, but of fortune.

Qui celat delictum, quærit amicitiam; sed qui altero sermone repetit, separat fœderatos.

Here caution is given, that reconcilement is better managed by an amnesty, and passing over that which is past, than by apologies and excusations.

In omni opere bono erit abundantia; ubi autem verba sunt plurima, ibi frequenter egestas.

Here is noted, that words and discourse abound most where there is idleness and want.

Primus in sua causa justus; sed venit altera pars, et inquirit in eum.

Here is observed that in all causes the first tale possesseth much, in such sort, that the prejudice thereby wrought will be hardly removed, except some abuse or falsity in the information be detected.

Verba bilinguis quasi simplicia, et ipsa perveniunt ad interiora ventris.

Here is distinguished, that flattery and insinuation, which seemeth set and artificial, sinketh not far; but that entereth deep which hath shew of nature, liberty, and simplicity.

Qui erudit derisorem, ipse sibi injuriam facit; et qui arguit impium, sibi maculam generat.

Here caution is given how we tender reprehension to arrogant and scornful natures, whose manner is to esteem it for contumely, and accordingly to return it.

Da sapienti occasionem, et addetur ei sapientia.

Here is distinguished the wisdom brought into

habit, and that which is but verbal, and swimming only in conceit; for the one upon the occasion presented is quickened and redoubled, the other is amazed and confused.

Quomodo in aquis resplendent vultus prospicientium, sic cordia hominum manifesta sunt prudentibus.

Here the mind of a wise man is compared to a glass, wherein the images of all diversity of natures and customs are represented, from which representation proceedeth that application,

Qui sapit, innumeris moribus aptus erit.

Thus have I staid somewhat longer upon these sentences politic of Solomon than is agreeable to the proportion of an example, led with a desire to give authority to this part of knowledge which I noted as deficient, by so excellent a precedent; and have also attended them with brief observations, such as to my understanding offer no violence to the sense, though I know they may be applied to a more divine use; but it is allowed even in divinity, that some interpretations, yea and some writings, have more of the eagle than others; but taking them as instructions for life, they might have received large discourse, if I would have broken them and illustrated them by deducements and examples.

Neither was this in use only with the Hebrews, but it is generally to be found in the wisdom of the more ancient times; that as men found out any observation that they thought was good for life, they would gather it and express it in parable, or aphorism, or fable. But for fables, they were vicegerents and supplies where examples failed: now that the times abound with history, the aim is better when the mark is alive. And therefore the form of writing, which of all others is the fittest for this variable argument of negociation and occasions, is that which Machiavel chose wisely and aptly for government; namely, discourse upon histories or examples: for knowledge drawn freshly, and in our view, out of particulars, knoweth the way best to particulars again; and it hath much greater life for practice when the

discourse attendeth upon the example, than when the example attendeth upon the discourse. For this is no point of order, as it seemeth at first, but of substance: for when the example is the ground, being set down in an history at large, it is set down with all circumstances, which may sometimes control the discourse thereupon made, and sometimes supply it as a very pattern for action; whereas the examples alleged for the discourse's sake, are cited succinctly, and without particularity, and carry a servile aspect toward the discourse which they are brought in to make good.

But this difference is not amiss to be remembered, that as history of times is the best ground for discourse of government, such as Machiavel handleth, so history of lives is the most proper for discourse of business, because it is more conversant in private actions. Nay, there is a ground of discourse for this purpose fitter than them both, which is discourse upon letters; such as are wise and weighty, as many are of Cicero *ad Atticum*, and others. For letters have a great and more particular representation of business than either chronicles or lives. Thus have we spoken both of the matter and form of this part of civil knowledge, touching negociation, which we note to be deficient.

But yet there is another part of this part, which differeth as much from that whereof we have spoken, as *sapere* and *sibi sapere;* the one moving as it were to the circumference, the other to the centre: for there is a wisdom of counsel, and again there is a wisdom of pressing a man's own fortune, and they do sometimes meet, and often sever: for many are wise in their own ways that are weak for government or counsel; like ants, which are wise creatures for themselves, but very hurtful for the garden. This wisdom the Romans did take much knowledge of: *Nam pol sapiens*, saith the comical poet, *fingit fortunam sibi;* and it grew to an adage, *Faber quisque fortunæ propriæ:* and Livy attributeth it to Cato the first, *in hoc viro tanta vis animi et ingenii inerat, ut quocunque loco natus esset, sibi ipse fortunam facturus videretur.*

This conceit or position, if it be too much declared

and professed, hath been thought a thing impolitic and unlucky, as was observed in Timotheus the Athenian; who having done many great services to the estate in his government, and giving an account thereof to the people, as the manner was, did conclude every particular with this clause, "and in this fortune had no part." And it came to pass that he never prospered in any thing he took in hand afterwards; for this is too high and too arrogant, savouring of that which Ezekiel saith of Pharaoh, *Dicis, Fluvius est meus, et ego feci memetipsum:* or of that which another prophet speaketh, that *men offer sacrifices to their nets and snares;* and that which the poet expresseth,

Dextra mihi Deus, et telum, quod missile libro.
Nunc adsint:

For these confidences were ever unhallowed, and unblessed: and therefore those that were great politicians indeed ever ascribed their successes to their felicity, and not to their skill or virtue. For so Sylla surnamed himself *Felix* not *Magnus:* so Cæsar said to the master of the ship, *Cæsarem portas et fortunam ejus.*

But yet nevertheless these positions, *Faber quisque fortunæ suæ; Sapiens dominabitur astris: Invia virtuti nulla est via,* and the like, being taken and used as spurs to industry, and not as stirrups to insolency, rather for resolution than for presumption or outward declaration, have been ever thought sound and good, and are, no question, imprinted in the greatest minds, who are so sensible of this opinion, as they can scarce contain it within: As we see in Augustus Cæsar, who was rather diverse from his uncle, than inferior in virtue, how when he died, he desired his friends about him to give him a *Plaudite,* as if he were conscious to himself that he had played his part well upon the stage. This part of knowledge we do report also as deficient; not but that it is practised too much, but it hath not been reduced to writing. And therefore lest it should seem to any that it is not comprehensible by axiom, it is requisite, as we did in the former, that we set down some heads or passages of it.

Faber fortunæ, sive de ambitu vitæ.

Wherein it may appear at the first a new and unwonted argument to teach men how to raise and make their fortune: a doctrine, wherein every man perchance will be ready to yield himself a disciple till he seeth difficulty; for fortune layeth as heavy impositions as virtue, and it is as hard and severe a thing to be a true politician, as to be truly moral. But the handling thereof concerneth learning greatly, both in honour and in substance: In honour, because pragmatical men may not go away with an opinion that learning is like a lark, that can mount, and sing, and please herself, and nothing else; but may know that she holdeth as well of the hawk, that can soar aloft, and can also descend and strike upon the prey. In substance, because it is the perfect law of inquiry of truth, "that nothing be in the globe of matter, "which should not be likewise in the globe of chrys-"tal, or form;" that is, that there be not any thing in being and action, which should not be drawn and collected into contemplation and doctrine. Neither doth learning admire or esteem of this architecture of fortune, otherwise than as of an inferior work: for no man's fortune can be an end worthy of his being, and many times the worthiest men do abandon their fortune willingly for better respects; but nevertheless fortune, as an organ of virtue and merit, deserveth the consideration.

First, therefore, the precept which I conceive to be most summary towards the prevailing in fortune, is to obtain that window which Momus did require; who seeing in the frame of man's heart such angles and recesses, found fault there was not a window to look into them; that is, to procure good informations of particulars touching persons, their natures, their desires and ends, their customs and fashions, their helps and advantages, and whereby they chiefly stand; so again their weaknesses and disadvantages, and where they lie most open and obnoxious; their friends, factions, and dependencies; and again their opposites, enviers, competitors, their moods and times, *Sola viri molles aditus et tempora noras;* their principles, rules,

and observations, and the like: and this not only of persons, but of actions, what are on foot from time to time, and how they are conducted, favoured, opposed, and how they import, and the like. For the knowledge of present actions is not only material in itself, but without it also the knowledge of persons is very erroneous; for men change with the actions, and whilst they are in pursuit they are one, and when they return to their nature they are another. These informations of particulars, touching persons and actions, are as the minor propositions in every active syllogism, for no excellency of observations, which are as the major propositions, can suffice to ground a conclusion, if there be error and mistaking in the minors.

That this knowledge is possible Solomon is our surety, who saith, *Consilium in corde viri tanquam aqua profunda, sed vir prudens exhauriet illud:* And although the knowledge itself falleth not under precept, because it is of individuals, yet the instructions for the obtaining of it may.

We will begin therefore with this precept, according to the ancient opinion, that the sinews of wisdom are slowness of belief and distrust; that more trust be given to countenances and deeds than to words; and in words, rather to sudden passages and surprised words than to set and purposed words. Neither let that be feared which is said, *fronti nulla fides;* which is meant of a general outward behaviour, and not of the private and subtile motions and labours of the countenance and gesture; which, as Q. Cicero elegantly saith, is *animi janua*, "the gate of the mind." None more close than Tiberius, and yet Tacitus saith of Gallus, *Etenim vultu offensionem conjectaverat.* So again, noting the differing character and manner of his commending Germanicus and Drusus in the senate, he saith, touching his fashion wherein he carried his speech of Germanicus, thus: *Magis in speciem adornatis verbis, quam ut penitus sentire videretur;* but of Drusus thus, *Paucioribus, sed intentior, et fida oratione:* and in another place, speaking of his cha-

racter of speech when he did any thing that was gracious and popular, he saith, that in other things he was *velut eluctantium verborum:* but then again, *Solutius vero loquebatur quando subvenerit.* So that there is no such artificer of dissimulation, nor no such commanded countenance, *vultus jussus*, that can sever from a feigned tale some of these fashions, either a more slight and careless fashion, or more set and formal, or more tedious and wandring, or coming from a man more drily and hardly.

Neither are deeds such assured pledges, as that they may be trusted without a judicious consideration of their magnitude and nature: *Fraus sibi in parvis fidem præstruit, ut majore emolumento fallat:* and the Italian thinketh himself upon the point to be bought and sold, when he is better used than he was wont to be, without manifest cause. For small favours, they do but lull men asleep, both as to caution and as to industry, and are, as Demosthenes calleth them, *Alimenta socordiæ.* So again we see how false the nature of some deeds are, in that particular which Mutianus practised upon Antonius Primus, upon that hollow and unfaithful reconcilement which was made between them: whereupon Mutianus advanced many of the friends of Antonius: *simul amicis ejus præfecturas et tribunatus largitur:* wherein, under pretence to strengthen him, he did desolate him, and won from him his dependences.

As for words, though they be like waters to physicians, full of flattery and uncertainty, yet they are not to be despised, specially with the advantage of passion and affection. For so we see Tiberius, upon a stinging and incensing speech of Agrippina, came a step forth of his dissimulation, when he said, "You are hurt, because you do not reign;" of which Tacitus saith, *Audita hæc raram occulti pectoris vocem elicuere, correptamque Græco versu admonuit: ideo lædi, quia non regnaret.* And therefore the poet doth elegantly call passions, tortures, that urge men to confess their secrets:

Vino tortus et ira.

And experience sheweth, there are few men so true to themselves, and so settled, but that, sometimes upon heat, sometimes upon bravery, sometimes upon kindness, sometimes upon trouble of mind and weakness, they open themselves; specially if they be put to it with a counter-dissimulation, according to the proverb of Spain, *Di mentira, y sacaras verdad,* "Tell a lie, "and find a truth."

As for the knowing of men, which is at second hand from reports: mens weakness and faults are best known from their enemies, their virtues and abilities from their friends, their customs and times from their servants, their conceits and opinions from their familiar friends, with whom they discourse most. General fame is light, and the opinions conceived by superiors or equals are deceitful; for to such, men are more masked, *Verior fama è domesticis emanat.*

But the soundest disclosing and expounding of men is, by their natures and ends; wherein the weakest sort of men are best interpreted by their natures, and the wisest by their ends. For it was both pleasantly and wisely said, though I think very untruly, by a nuncio of the pope, returning from a certain nation, where he served as lieger; whose opinion being asked touching the appointment of one to go in his place, he wished that in any case they did not send one that was too wise; because no very wise man would ever imagine, what they in that country were like to do: and certainly it is an error frequent for men to shoot over, and to suppose deeper ends, and more compass-reaches than are: the Italian proverb being elegant, and for the most part true,

Di danari, di senno, e di fede,
Ce' nè manco che non credi:

"There is commonly less money, less wisdom, and "less good faith, than men do account upon."

But princes, upon a far other reason, are best interpreted by their natures, and private persons by their ends: for princes being at the top of human desires, they have for the most part no particular

ends whereto they aspire, by distance from which a man might take measure and scale of the rest of their actions and desires; which is one of the causes that maketh their hearts more inscrutable. Neither is it sufficient to inform ourselves in mens ends and natures of the variety of them only, but also of the predominancy, what humor reigneth most, and what end is principally sought. For so we see, when Tigellinus saw himself out-stripped by Petronius Turpilianus in Nero's humors of pleasures; *metus ejus rimatur*, he wrought upon Nero's fears, whereby he broke the other's neck.

But to all this part of inquiry, the most compendious way resteth in three things: the first, to have general acquaintance and inwardness with those which have general acquaintance, and look most into the world; and especially according to the diversity of business, and the diversity of persons, to have privacy and conversation with some one friend at least, which is perfect and well intelligenced in every several kind. The second is, to keep a good mediocrity in liberty of speech and secrecy: in most things liberty, secrecy where it importeth; for liberty of speech inviteth and provoketh liberty to be used again, and so bringeth much to a man's knowledge; and secrecy, on the other side, induceth trust and inwardness. The last is the reducing of a man's self to this watchful and serene habit, as to make account and purpose, in every conference and action, as well to observe as to act. For as Epictetus would have a philosopher in every particular action to say to himself, *Et hoc volo, et etiam institutum servare:* so a politic man in every thing should say to himself, *Et hoc volo, ac etiam aliquid addiscere.* I have stayed the longer upon this precept of obtaining good information; because it is a main part by itself, which answereth to all the rest. But above all things caution must be taken, that men have a good stay and hold of themselves, and that this much knowing do not draw on much meddling; for nothing is more unfortunate than

light and rash intermeddling in many matters. So that this variety of knowledge tendeth in conclusion but only to this, to make a better and freer choice of those actions which may concern us, and to conduct them with the less error and the more dexterity.

The second precept concerning this knowledge, is for men to make good information touching their own persons, and well to understand themselves: knowing that, as St. James saith, though men look oft in a glass, yet they do suddenly forget themselves; wherein as the divine glass is the word of God, so the politic glass is the state of the world, or times wherein we live, in the which we are to behold ourselves.

For men ought to take an impartial view of their own abilities and virtues; and again of their wants and impediments; accounting these with the most; and those other with the least; and from this view and examination, to frame the considerations following.

First, to consider how the constitution of their nature sorteth with the general state of the times; which if they find agreeable and fit, then in all things to give themselves more scope and liberty; but if differing and dissonant, then in the whole course of their life to be more close, retired, and reserved: as we see in Tiberius, who was never seen at a play, and came not into the senate in twelve of his last years; whereas Augustus Cæsar lived ever in mens eyes, which Tacitus observeth: *Alia Tiberio morum via.*

Secondly, to consider how their nature sorteth with professions and courses of life, and accordingly to make election, if they be free; and, if engaged, to make the departure at the first opportunity, as we see was done by duke Valentine, that was designed by his father to a sacerdotal profession, but quitted it soon after in regard of his parts and inclination; being such nevertheless, as a man cannot tell well whether they were worse for a prince or for a priest.

Thirdly, to consider how they sort with those

whom they are like to have competitors and concurrents, and to take that course wherein there is most solitude, and themselves like to be most eminent; as Julius Cæsar did, who at first was an orator or pleader; but when he saw the excellency of Cicero, Hortensius, Catulus, and others, for eloquence, and saw there was no man of reputation for the wars but Pompeius, upon whom the state was forced to rely; he forsook his course begun toward a civil and popular greatness, and transferred his designs to a martial greatness.

Fourthly, in the choice of their friends and dependences, to proceed according to the composition of their own nature; as we may see in Cæsar; all whose friends and followers were men active and effectual, but not solemn, or of reputation.

Fifthly, to take special heed how they guide themselves by examples, in thinking they can do as they see others do; whereas perhaps their natures and carriages are far differing. In which error it seemeth Pompey was, of whom Cicero saith, that he was wont often to say, *Sylla potuit, ego non potero?* Wherein he was much abused, the natures and proceedings of himself and his example, being the unlikest in the world; the one being fierce, violent, and pressing the fact; the other solemn, and full of majesty and circumstance; and therefore the less effectual.

But this precept touching the politic knowledge of ourselves, hath many other branches whereupon we cannot insist.

Next to the well understanding and discerning of a man's self, there followeth the well opening and revealing a man's self; wherein we see nothing more usual than for the more able man to make the less shew. For there is a great advantage in the well setting forth of a man's virtues, fortunes, merits; and again, in the artificial covering of a man's weaknesses, defects, disgraces, staying upon the one, sliding from the other; cherishing the one by circumstances, gracing the other by exposition, and the like; wherein

we see what Tacitus saith of Mutianus, who was the greatest politician of his time, *Omnium, quæ dixerat, feceratque, arte quadam ostentator;* which requireth indeed some art, lest it turn tedious and arrogant; but yet so, as ostentation, though it be to the first degree of vanity, seemeth to me rather a vice in manners than in policy: for as it is said, *Audacter calumniare, semper aliquid hæret;* so except it be in a ridiculous degree of deformity, *Audacter te vendita, semper aliquid hæret.* For it will stick with the more ignorant and inferior sort of men, though men of wisdom and rank do smile at it, and despise it; and yet the authority won with many, doth countervail the disdain of a few. But if it be carried with decency and government, as with a natural, pleasant, and ingenuous fashion, or at times when it is mixed with some peril and unsafety, as in military persons, or at times when others are most envied; or with easy and careless passage to it and from it, without dwelling too long, or being too serious; or with an equal freedom of taxing a man's self, as well as gracing himself; or by occasion of repelling or putting down others injury or insolence; it doth greatly add to reputation; and surely not a few solid natures that want this ventosity, and cannot sail in the height of the winds, are not without some prejudice and disadvantage by their moderation.

But for these flourishes and enhancements of virtue, they are not perchance unnecessary, so it is at least necessary that virtue be not disvalued and imbased under the just price, which is done in three manners; by offering and obtruding a man's self, wherein men think he is rewarded, when he is accepted: by doing too much, which will not give that which is well done leave to settle, and in the end induceth satiety: and by finding too soon the fruit of a man's virtue, in commendation, applause, honour, favour; wherein if a man be pleased with a little, let him hear what is truly said; *Cave ne insuetus rebus majoribus videaris, si hæc te res parva, sicuti magna delectat.*

But the covering of defects is of no less importance than the valuing of good parts: which may be done likewise in three manners, by caution, by colour, and by confidence. Caution is, when men do ingeniously and discreetly avoid to be put into those things for which they are not proper: whereas contrariwise, bold and unquiet spirits will thrust themselves into matters without difference, and so publish and proclaim all their wants: colour is, when men make a way for themselves, to have a construction made of their faults or wants, as proceeding from a better cause, or intended for some other purpose: for of the one it is well said,

Sæpe latet vitium proximitate boni.

And therefore whatsoever want a man hath, he must see that he pretend the virtue that shadoweth it; as if he be dull, he must affect gravity; if a coward, mildness; an so the rest. For the second, a man must frame some probable cause why he should not do his best, and why he should dissemble his abilities; and for that purpose must use to dissemble those abilities which are notorious in him, to give colour that his true wants are but industries and dissimulations. For confidence, it is the last, but surest remedy; namely, to depress and seem to despise whatsoever a man cannot attain, observing the good principle of the merchants, who endeavour to raise the price of their own commodities, and to beat down the price of others. But there is a confidence that passeth this other, which is, to face out a man's own defects, in seeming to conceive that he is best in those things wherein he is failing; and, to help that again, to seem on the other side that he hath least opinion of himself in those things wherein he is best; like as we shall see it commonly in poets, that if they shew their verses, and you except to any, they will say, "that that line cost them more labour than any of the "rest;" and presently will seem to disable and suspect rather some other line, which they know well enough to be the best in the number. But above all, in this righting and helping of a man's self in his own car-

riage, he must take heed he shew not himself dismantled, and exposed to scorn and injury, by too much sweetness, goodness, and facility of nature, but shew some sparkles of liberty, spirit, and edge: which kind of fortified carriage, with a ready rescuing of a man's self from scorns, is sometimes of necessity imposed upon men by somewhat in their person or fortune, but it ever succeedeth with good felicity.

Another precept of this knowledge is, by all possible endeavour to frame the mind to be pliant and obedient to occasion; for nothing hindereth mens fortunes so much as this: *Idem manebat, neque idem decebat.* Men are where they were, when occasions turn; and therefore to Cato, whom Livy maketh such an architect of fortune, he addeth, that he had *versatile ingenium.* And thereof it cometh, that these grave solemn wits, which must be like themselves, and cannot make departures, have more dignity than felicity. But in some it is nature to be somewhat viscous and inwrapped, and not easy to turn. In some it is a conceit, that is almost a nature, which is, that men can hardly make themselves believe that they ought to change their course, when they have found good by it in former experience; for Machiavel noteth wisely, how Fabius Maximus would have been temporizing still, according to his old bias, when the nature of the war was altered, and required hot pursuit. In some other it is want of point and penetration in their judgment, that they do not discern when things have a period, but come in too late after the occasion; as Demosthenes compareth the people of Athens to country fellows, when they play in a fence school, that if they have a blow, then they remove the weapon to that ward, and not before. In some other it is a lothness to lose labours passed, and a conceit that they can bring about occasions to their ply; and yet in the end, when they see no other remedy, then they come to it with disadvantage; as Tarquinius, that gave for the third part of Sibyla's book the treble price, when he might at first have had all three for the simple. But from whatso-

ever root or cause this restiveness of mind proceedeth, it is a thing most prejudicial, and nothing is more politic than to make the wheels of our mind concentric and voluble with the wheels of fortune.

Another precept of this knowledge, which hath some affinity with that we last spoke of, but with difference, is that which is well expressed, *fatis accede deisque*, that men do not only turn with the occasions, but also run with the occasions, and not strain their credit or strength to over-hard or extreme points; but choose in their actions that which is most passable: for this will preserve men from foil, not occupy them too much about one matter, win opinion of moderation, please the most, and make a shew of a perpetual felicity in all they undertake; which cannot but mightily increase reputation.

Another part of this knowledge seemeth to have some repugnancy with the former two, but not as I understand it, and it is that which Demosthenes uttereth in high terms: *Et quemadmodum receptum est, ut exercitum ducat imperator, sic et à cordatis viris res ipsæ ducendæ; ut quæ ipsis videntur, ea gerantur, et non ipsi eventus tantum persequi cogantur.* For, if we observe, we shall find two differing kinds of sufficiency in managing of business: some can make use of occasions aptly and dextrously, but plot little: some can urge and pursue their own plots well, but cannot accommodate nor take in; either of which is very imperfect without the other.

Another part of this knowledge is the observing a good mediocrity in the declaring, or not declaring a man's self: for although depth of secrecy, and making way, *qualis est via navis in mari*, which the French calleth *sourdes menées*, when men set things in work without opening themselves at all, be sometimes both prosperous and admirable, yet many times *Dissimulatio errores parit, qui dissimulatorem ipsum illaqueant.* And therefore, we see, the greatest politicians have in a natural and free manner professed their desires, rather than been reserved and disguised in them: for so we see that Lucius Scilla made a kind

of profession, "that he wished all men happy or unhappy, as they stood his friends or enemies." So Cæsar, when he first went into Gaul, made no scruple to profess, "that he had rather be first in a village, than second at Rome." So again, as soon as he had begun the war, we see what Cicero saith of him, *Alter*, meaning of Cæsar, *non recusat, sed quodammodo postulat, ut, ut est sic appelletur tyrannus.* So we may see in a letter of Cicero to Atticus, that Augustus Cæsar, in his very entrance into affairs, when he was a darling of the senate, yet in his harangues to the people would swear: *Ita parentis honores consequi liceat*, which was no less than the tyranny, save that, to help it, he would stretch forth his hand towards a statue of Cæsar's, that was erected in the place: and men laughed, and wondered, and said, Is it possible, or did you ever hear the like? and yet thought he meant no hurt, he did it so handsomely and ingenuously. And all these were prosperous: whereas Pompey, who tended to the same end, but in a more dark and dissembling manner, as Tacitus saith of him, *Occultior, non melior*, wherein Sallust concurreth, *ore probo, animo inverecundo*, made it his design, by infinite secret engines, to cast the state into an absolute anarchy and confusion, that the state might cast itself into his arms for necessity and protection, and so the sovereign power be put upon him, and he never seen in it: and when he had brought it, as he thought, to that point when he was chosen consul alone, as never any was, yet he could make no great matter of it, because men understood him not; but was fain in the end to go the beaten track of getting arms into his hands, by colour of the doubt of Cæsar's designs: so tedious, casual, and unfortunate are these deep dissimulations; whereof, it seemeth, Tacitus made this judgment, that they were a cunning of an inferior form in regard of true policy, attributing the one to Augustus, the other to Tiberius, where, speaking of Livia, he saith, *Et cum artibus mariti, simulatione filii bene composita;* for surely the continual habit of dissimulation is but a weak and sluggish cunning, and not greatly politic.

Another precept of this architecture of fortune is, to accustom our minds to judge of the proportion or value of things, as they conduce and are material to our particular ends; and that to do substantially and not superficially. For we shall find the logical part, as I may term it, of some mens minds good, but the mathematical part erroneous; that is, they can well judge of consequences, but not of proportions and comparisons, preferring things of shew and sense before things of substance and effect. So some fall in love with access to princes, others with popular fame and applause, supposing they are things of great purchase; when in, many cases, they are but matters of envy, peril, and impediment.

So some measure things according to the labor and difficulty, or assiduity, which are spent about them; and think if they be ever moving, that they must needs advance and proceed: as Cæsar saith in a despising manner of Cato the second, when he describeth how laborious and indefatigable he was to no great purpose; *Hæc omnia magno studio agebat.* So in most things men are ready to abuse themselves in thinking the greatest means to be best, when it should be the fittest.

As for the true marshalling of mens pursuits towards their fortune, as they are more or less material, I hold them to stand thus: first, the amendment of their own minds; for the remove of the impediments of the mind will sooner clear the passages of fortune, than the obtaining fortune will remove the impediments of the mind. In the second place I set down wealth and means, which, I know, most men would have placed first, because of the general use which it beareth towards all variety of occasions. But that opinion I may condemn with like reason as Machiavel doth that other, that moneys were the sinews of the wars, whereas, saith he, the true sinews of the wars are the sinews of men's arms, that is, a valiant, populous, and military nation; and he voucheth aptly the authority of Solon, who when Crœsus shewed him his treasury of gold, said to him, that if ano-

ther came that had better iron, he would be master of his gold. In like manner it may be truly affirmed, that it is not moneys that are the sinews of fortune, but it is the sinews and steel of mens minds, wit, courage, audacity, resolution, temper, industry, and the like. In the third place I set down reputation, because of the peremptory tides and currents it hath, which if they be not taken in their due time, are seldom recovered, it being extreme hard to play an after-game of reputation. And lastly I place honour, which is more easily won by any of the other three, much more by all, than any of them can be purchased by honour. To conclude this precept, as there is order and priority in matter, so is there in time, the preposterous placing whereof is one of the commonest errors, while men fly to their ends when they should intend their beginnings; and do not take things in order of time as they come on, but marshal them according to greatness, and not according to instance, not observing the good precept, *Quod nunc instat agamus.*

Another precept of this knowledge is, not to embrace any matters which do occupy too great a quantity of time, but to have that sounding in a man's ears, *Sed fugit interea, fugit irreparabile tempus:* and that is the cause why those which take their course of rising by professions of burden, as lawyers, orators, painful divines, and the like, are not commonly so politic for their own fortune, otherwise than in their ordinary way, because they want time to learn particulars, to wait occasions, and to devise plots.

Another precept of this knowledge is, to imitate nature, which doth nothing in vain; which surely a man may do if he do well interlace his business, and bend not his mind too much upon that which he principally intendeth. For a man ought in every particular action so to carry the motions of his mind, and so to have one thing under another, as if he cannot have that he seeketh in the best degree, yet to have it in a second, or so in a third; and if he can have no part of that which he purposed, yet to turn the use of

it to somewhat else; and if he cannot make any thing of it for the present, yet to make it as a seed of somewhat in time to come; and if he can contrive no effect or substance from it, yet to win some good opinion by it, or the like. So that he should exact an account of himself of every action, to reap somewhat, and not to stand amazed and confused if he fail of that he chiefly meant: for nothing is more impolitic than to mind actions wholly one by one; for he that doth so, loseth infinite occasions which intervene, and are many times more proper and propitious for somewhat that he shall need afterwards, than for that which he urgeth for the present; and therefore men must be perfect in that rule, *Hæc oportet facere, et illa non omittere.*

Another precept of this knowledge is, not to engage a man's self peremptorily in any thing, though it seem not liable to accident, but ever to have a window to fly out at, or a way to retire; following the wisdom in the ancient fable of the two frogs, which consulted when their plash was dry whither they should go, and the one moved to go down into a pit, because it was not likely the water would dry there, but the other answered, "True, but if it do, how shall we get out again?"

Another precept of this knowledge is, that ancient precept of Bias, construed not to any point of perfidiousness, but only to caution and moderation, *Et ama tanquam inimicus futurus, et odi tanquam amaturus:* for it utterly betrayeth all utility for men to embark themselves too far in unfortunate friendships, troublesome spleens, and childish and humorous envies or emulations.

But I continue this beyond the measure of an example, led, because I would not have such knowledges, which I note as deficient, to be thought things imaginative, or in the air; or an observation or two much made of, but things of bulk and mass, whereof an end is hardlier made than a beginning. It must be likewise conceived that in those points which I mention and set down, they are far from complete

tractates of them, but only as small pieces for patterns: and lastly, no man, I suppose, will think that I mean fortunes are not obtained without all this ado; for I know they come tumbling into some mens laps, and a number obtain good fortunes by diligence in a plain way, little intermeddling, and keeping themselves from gross errors.

But as Cicero, when he setteth down an idea of a perfect orator, doth not mean that every pleader should be such; and so likewise, when a prince or a courtier hath been described by such as have handled those subjects, the mould hath used to be made according to the perfection of the art, and not according to common practice: so I understand it, that it ought to be done in the description of a politic man, I mean politic for his own fortune.

But it must be remembered all this while, that the precepts which we have set down are of that kind which may be counted and called *bonæ artes*. As for evil arts, if a man would set down for himself that principle of Machiavel; "that a man seek not "to attain virtue itself, but the appearance only "thereof; because the credit of virtue is a help, but "the use of it is cumber:" or that other of his principles; "that he presuppose that men are not fitly to "be wrought otherwise but by fear, and therefore "that he seek to have every man obnoxious, low, "and in strait," which the Italians call *seminar spine*, to sow thorns: or that other principle contained in the verse which Cicero citeth, *Cadant amici, dummodo inimici intercidant*, as the Triumvirs, which sold, every one to other, the lives of their friends, for the deaths of their enemies: or that other protestation of L. Catilina, to set on fire, and trouble states, to the end to fish in droumy waters, and to unwrap their fortunes, *Ego si quid in fortunis meis excitatum sit incendium, id non aqua, sed ruina restinguam:* or that other principle of Lysander, "that children are to be "deceived with comfits, and men with oaths:" and the like evil and corrupt positions, whereof, as in all things, there are more in number than of the good:

certainly, with these dispensations from the laws of charity and integrity, the pressing of a man's fortune may be more hasty and compendious. But it is in life, as it is in ways, the shortest way is commonly the foulest, and surely the fairer way is not much about.

But men, if they be in their own power, and do bear and sustain themselves, and be not carried away with a whirlwind or tempest of ambition, ought, in the pursuit of their own fortune, to set before their eyes, not only that general map of the world, that *all things are vanity and vexation of spirit*, but many other more particular cards and directions: chiefly that, that being, without well-being, is a curse, and the greater being the greater curse; and that all virtue is most rewarded, and all wickedness most punished in itself: according as the poet saith excellently:

Quæ vobis quæ digna viri, pro laudibus istis
Præmia posse rear solvi? pulcherrima primum
Dii moresque dabunt vestri.

And so of the contrary. And, secondly, they ought to look up to the eternal providence and divine judgment, which often subverteth the wisdom of evil plots and imaginations, according to that Scripture, *He hath conceived mischief, and shall bring forth a vain thing*. And although men should refrain themselves from injury and evil arts, yet this incessant and sabbathless pursuit of a man's fortune leaveth not that tribute which we owe to God of our time: who, we see, demandeth a tenth of our substance, and a seventh, which is more strict, of our time: and it is to small purpose to have an erected face towards heaven, and a perpetual groveling spirit upon earth, eating dust, as doth the serpent, *Atque affigit humo divinæ particulam auræ*. And if any man flatter himself that he will employ his fortune well, though he should obtain it ill, as was said concerning Augustus Cæsar, and after of Septimius Severus, "that either "they should never have been born, or else they "should never have died," they did so much mischief

in the pursuit and ascent of their greatness, and so much good when they were established: yet these compensations and satisfactions are good to be used, but never good to be purposed. And, lastly, it is not amiss for men in their race towards their fortune, to cool themselves a little with that conceit which is elegantly expressed by the emperor Charles the fifth, in his instructions to the king his son, "that fortune "hath somewhat of the nature of a woman, that if "she be too much wooed, she is the farther off." But this last is but a remedy for those whose tastes are corrupted; let men rather build upon that foundation which is as a corner-stone of divinity and philosophy, wherein they join close, namely, that same *Primum quærite.* For divinity saith, *Primum quærite regnum Dei, et ista omnia adjicientur vobis:* and philosophy saith, *Primum quærite bona animi, cætera aut aderunt, aut non oberunt.* And although the human foundation hath somewhat of the sands, as we see in M. Brutus, when he brake forth in that speech,

Te colui, virtus, ut rem: ast tu nomen inane es:

yet the divine foundation is upon the rock. But this may serve for a taste of that knowledge which I noted as deficient.

Concerning Government, it is a part of knowledge, secret and retired in both these respects, in which things are deemed secret; for some things are secret because they are hard to know, and some because they are not fit to utter; we see all governments are obscure and invisible.

Totamque infusa per artus,
Mens agitat molem, et magno se corpore miscet.

Such is the description of governments: we see the government of God over the world is hidden, insomuch as it seemeth to participate of much irregularity and confusion: the government of the soul in moving the body is inward and profound, and the passages thereof hardly to be reduced to demonstration. Again, the wisdom of antiquity, the shadows whereof are in the poets, in the description of torments and pains, next unto the crime of rebellion, which was the giants

offence, doth detest the crime of futility, as in Sisyphus and Tantalus. But this was meant of particulars; nevertheless even unto the general rules and discourses of policy and government there is due a reverent and reserved handling.

But, contrariwise, in the governors towards the governed, all things ought, as far as the frailty of man permitteth, to be manifest and revealed. For so it is expressed in the Scriptures touching the government of God, that this globe which seemeth to us a dark and shady body, is in the view of God as crystal, *Et in conspectu sedis tanquam mare vitreum simile crystallo.* So unto princes and states, specially towards wise senates and councils, the natures and dispositions of the people, their conditions and necessities, their factions and combinations, their animosities and discontents, ought to be, in regard of the variety of their intelligences, the wisdom of their observations, and the height of the station, where they keep centinel, in great part clear and transparent. Wherefore, considering that I write to a king that is a master of this science, and is so well assisted, I think it decent to pass over this part in silence, as willing to obtain the certificate which one of the ancient philosophers aspired unto; who being silent when others contended to make demonstration of their abilities by speech, desired it might be certified for his part, "that there was one that knew how to "hold his peace."

Notwithstanding, for the more public part of government, which is laws, I think good to note only one deficiency: which is, that all those which have written of laws, have written either as philosophers, or as lawyers, and none as statesmen. As for the philosophers, they make imaginary laws for imaginary commonwealths, and their discourses are as the stars, which give little light, because they are so high. For the lawyers, they write according to the states where they live, what is received law, and not what ought to be law; for the wisdom of a lawmaker is one, and of a lawyer is another. For there are in nature

certain fountains of justice, whence all civil laws are derived but as streams: and like as waters do take tinctures and tastes from the soils through which they run, so do civil laws vary according to the regions and governments where they are planted, though they proceed from the same fountains. Again, the wisdom of a lawmaker consisteth not only in a platform of justice, but in the application thereof; taking into consideration, by what means laws may be made certain, and what are the causes and remedies of the doubtfulness and incertainty of law; by what means laws may be made apt and easy to be executed, and what are the impediments and remedies in the execution of laws; what influence laws touching private right of *meum* and *tuum* have into the public state, and how they may be made apt and agreeable; how laws are to be penned and delivered, whether in texts or in acts, brief or large, with preambles, or without; how they are to be pruned and reformed from time to time, and what is the best means to keep them from being too vast in volumes, or too full of multiplicity and crossness; how they are to be expounded, when upon causes emergent and judicially discussed; and when upon responses and conferences touching general points or questions; how they are to be pressed rigorously or tenderly; how they are to be mitigated by equity and good conscience, and whether discretion and strict law are to be mingled in the same courts, or kept apart in several courts; again, how the practice, profession, and erudition of law is to be censured and governed; and many other points touching the administration, and, as I may term it, animation of laws. Upon which I insist the less, because I propose, if God give me leave, having begun a good work of this nature, in aphorisms, to propound it hereafter, noting it in the mean time for deficient.

De prudentia legislatoria, sive de fontibus juris.

And for your majesty's laws of England, I could say much of their dignity, and somewhat of their defect; but they cannot but excel the civil laws in fitness for the government; for the civil law was,

Non hos quæsitum manus in usus; it was not made for the countries which it governeth: hereof I cease to speak, because I will not intermingle matter of action with matter of general learning.

Thus have I concluded this portion of learning touching civil knowledge, and with civil knowledge have concluded human philosophy; and with human philosophy, philosophy in general; and being now at some pause, looking back into that I have passed through, this writing seemeth to me, *si nunquam fallit imago*, as far as a man can judge of his own work, not much better than that noise or sound which musicians make while they are in tuning their instruments, which is nothing pleasant to hear, but yet is a cause why the music is sweeter afterwards. So have I been content to tune the instruments of the muses, that they may play that have better hands. And surely, when I set before me the condition of these times, in which learning hath made her third visitation or circuit in all the qualities thereof; as the excellency and vivacity of the wits of this age; the noble helps and lights which we have by the travels of ancient writers; the art of printing, which communicateth books to men of all fortunes; the openness of the world by navigation, which hath disclosed multitudes of experiments, and a mass of natural history: the leisure wherewith these times abound, not employing men so generally in civil business, as the states of Græcia did, in respect of their popularity, and the state of Rome in respect of the greatness of their monarchy; the present disposition of these times at this instant to peace; the consumption of all that ever can be said in controversies of religion, which have so much diverted men from other sciences; the perfection of your majesty's learning, which as a phœnix may call whole vollies of wits to follow you; and the inseparable propriety of time, which is ever more and more to disclose truth; I cannot but be raised to this persuasion, that this third period of time will far surpass that of the Græcian

and Roman learning: only if men will know their own strength, and their own weakness both; and take one from the other, light of invention, and not fire of contradiction; and esteem of the inquisition of truth, as of an enterprise, and not as of a quality or ornament; and employ wit and magnificence to things of worth and excellency, and not to things vulgar and of popular estimation. As for my labours, if any man shall please himself, or others, in the reprehension of them, they shall make that ancient and patient request, *Verbera, sed audi.* Let men reprehend them, so they observe and weigh them. For the appeal is lawful, though it may be it shall not be needful, from the first cogitations of men to their second, and from the nearer times to the times farther off. Now let us come to that learning, which both the former times were not so blessed as to know, sacred and inspired Divinity, the sabbath and port of all mens labours and peregrinations.

The prerogative of God extendeth as well to the reason, as to the will of man; so that as we are to obey his law, though we find a reluctation in our will; so we are to believe his word, though we find a reluctation in our reason. For if we believe only that which is agreeable to our sense, we give consent to the matter, and not to the author, which is no more than we would do towards a suspected and discredited witness: but that faith which was *accounted to Abraham for righteousness*, was of such a point, as whereat Sarah laughed, who therein was an image of natural reason.

Howbeit, if we will truly consider it, more worthy it is to believe than to know as we now know. For in knowledge man's mind suffereth from sense, but in belief it suffereth from spirit, such one as it holdeth for more authorised than itself; and so suffereth from the worthier agent. Otherwise it is of the state of man glorified, for then faith shall cease, and *we shall know as we are known.*

Wherefore we conclude, that sacred theology,

which in our idiom we call divinity, is grounded only upon the word and oracle of God, and not upon the light of nature: for it is written, *Cæli enarrant gloriam Dei:* but it is not written, *Cæli enarrant voluntatem Dei:* but of that it is said, *Ad legem et testimonium, si non fecerint secundum verbum istud, etc.* This holdeth not only in those points of faith which concern the great mysteries of the Deity, of the creation, of the redemption, but likewise those which concern the law moral truly interpreted; *Love your enemies: do good to them that hate you: be like to your heavenly Father, that suffereth his rain to fall upon the just and unjust.* To this it ought to be applauded, *Nec vox hominem sonat*, it is a voice beyond the light of nature. So we see the heathen poets, when they fall upon a libertine passion, do still expostulate with laws and moralities, as if they were opposite and malignant to nature; *Et quod natura remittit, Invida jura negant.* So said Dendamis the Indian unto Alexander's messengers; "That he had heard "somewhat of Pythagoras, and some other of the "wise men of Græcia, and that he held them for "excellent men: but that they had a fault, which "was, that they had in too great reverence and ve-"neration a thing they called law and manners." So it must be confessed that a great part of the law moral is of that perfection, whereunto the light of nature cannot aspire: how then is it, that man is said to have, by the light and law of nature, some notions and conceits of virtue and vice, justice and wrong, good and evil? Thus, because the light of nature is used in two several senses; the one, that which springeth from reason, sense, induction, argument, according to the laws of heaven and earth; the other, that which is imprinted upon the spirit of man by an inward instinct, according to the law of conscience, which is a sparkle of the purity of his first estate: in which latter sense only he is participant of some light and discerning touching the perfection of the moral law: but how? Sufficient to check the vice, but not to inform the duty. So then the doctrine of religion,

as well moral as mystical, is not to be attained, but by inspiration and revelation from God.

The use, notwithstanding, of reason, in spiritual things, and the latitude thereof, is very great and general; for it is not for nothing that the apostle calleth religion our *reasonable service* of God, insomuch as the very ceremonies and figures of the old law were full of reason and signification, much more than the ceremonies of idolatry and magic, that are full of non-significants and surd characters. But most especially the christian faith, as in all things, so in this, deserveth to be highly magnified, holding and preserving the golden mediocrity in this point, between the law of the heathen, and the law of Mahomet, which have embraced the two extremes. For the religion of the heathen had no constant belief or confession, but left all to the liberty of argument; and the religion of Mahomet, on the other side, interdicteth argument altogether: the one having the very face of error, and the other of imposture; whereas the faith doth both admit and reject disputation with difference.

The use of human reason in religion is of two sorts: the former, in the conception and apprehension of the mysteries of God to us revealed; the other, in the inferring and deriving of doctrine and direction thereupon. The former extendeth to the mysteries themselves; but how? By way of illustration, and not by way of argument. The latter consisteth indeed of probation and argument. In the former, we see, God vouchsafeth to descend to our capacity, in the expressing of his mysteries in such sort as may be sensible unto us; and doth graft his revelations and holy doctrine upon the notions of our reason, and applieth his inspirations to open our understanding, as the form of the key to the ward of the lock. For the latter there is allowed us an use of reason and argument, secondary and respective, although not original and absolute. For after the articles and principles of religion are placed and exempted from examination of reason, it is then per-

mitted unto us to make derivations and inferences from, and according to the analogy of them, for our better direction. In nature this holdeth not, for both the principles are examinable by induction, though not by a medium or syllogism; and, besides, those principles or first positions have no discordance with that reason, which draweth down and deduceth the inferior positions. But yet it holdeth not in religion alone, but in many knowledges, both of greater and smaller nature, namely, wherein there are not only *posita* but *placita;* for in such there can be no use of absolute reason: we see it familiarly in games of wit, as chess, or the like; the draughts and first laws of the game are positive, but how? Merely *ad placitum*, and not examinable by reason: but then how to direct our play thereupon with best advantage to win the game, is artificial and rational. So in human laws, there be many grounds and maxims, which are *placita juris*, positive upon authority, and not upon reason, and therefore not to be disputed: but what is most just, not absolutely, but relatively and according to those maxims, that affordeth a long field of disputation. Such therefore is that secondary reason, which hath place in divinity, which is grounded upon the *placets* of God.

De usu legitimo rationis humanæ in divinis.

Here therefore I note this deficiency, that there hath not been, to my understanding, sufficiently inquired and handled the true limits and use of reason in spiritual things, as a kind of divine dialectic: which for that it is not done, it seemeth to me a thing usual, by pretext of true conceiving that which is revealed, to search and mine into that which is not revealed, and, by pretext of enucleating inferences and contradictories, to examine that which is positive: the one sort falling into the error of Nicodemus, demanding to have things made more sensible than it pleaseth God to reveal them, *Quomodo possit homo nasci cum sit senex?* the other sort into the error of the disciples, which were scandalized at a shew of contradiction, *Quid est hoc, quod dicit nobis? Modicum et non videbitis me, et iterum modicum, et videbitis me, etc.*

Upon this I have insisted the more, in regard of the great and blessed use thereof; for this point, well laboured and defined of, would, in my judgment, be an opiate to stay and bridle not only the vanity of curious speculations, wherewith the schools labor, but the fury of controversies, wherewith the church laboureth. For it cannot but open mens eyes, to see that many controversies do merely pertain to that which is either not revealed, or positive, and that many others do grow upon weak and obscure inferences or derivations; which latter sort, if men would revive the blessed stile of that great doctor of the Gentiles, would be carried thus; *Ego, non Dominus;* and again, *Secundum consilium meum;* in opinions and counsels, and not in positions and oppositions. But men are now over-ready to usurp the stile, *Non ego, sed Dominus;* and not so only, but to bind it with the thunder and denunciation of curses and anathemas, to the terror of those which have not sufficiently learned out of Solomon, that *the causeless curse shall not come.*

Divinity hath two principal parts; the matter informed or revealed, and the nature of the information or revelation: and with the latter we will begin, because it hath most coherence with that which we have now last handled. The nature of the information consisteth of three branches; the limits of the information, the sufficiency of the information, and the acquiring or obtaining the information. Unto the limits of the information, belong these considerations; how far forth particular persons continue to be inspired; how far forth the church is inspired; and how far forth reason may be used: the last point whereof I have noted as deficient. Unto the sufficiency of the information belong two considerations; what points of religion are fundamental, and what perfective, being matter of farther building and perfection upon one and the same foundation; and again, how the gradations of light, according to the dispensation of times, are material to the sufficiency of belief.

De gradibus unitatis in civitate Dei.

Here again I may rather give it in advice, than note it as deficient, that the points fundamental, and the points of farther perfection only ought to be with piety and wisdom distinguished; a subject tending to much like end, as that I noted before; for as that other were likely to abate the number of controversies, so this is like to abate the heat of many of them. We see Moses when he saw the Israelite and the Ægyptian fight, he did not say, *Why strive you?* but drew his sword and slew the Ægyptian: but when he saw the two Israelites fight, he said, *You are brethren, why strive you?* If the point of doctrine be an Ægyptian, it must be slain by *the sword of the Spirit*, and not reconciled: but if it be an Israelite, though in the wrong, then, *Why strive you?* We see of the fundamental points, our Saviour penneth the league thus, *He that is not with us, is against us;* but of points not fundamental, thus; *He that is not against us, is with us.* So we see the coat of our Saviour was intire without seam, and so is the doctrine of the Scriptures in itself; but the garment of the church was of divers colours, and yet not divided: we see the chaff may and ought to be severed from the corn in the ear, but the tares may not be pulled up from the corn in the field. So as it is a thing of great use well to define, what, and of what latitude those points are, which do make men merely aliens and disincorporate from the church of God.

For the obtaining of the information, it resteth upon the true and sound interpretation of the Scriptures, which are the fountains of the water of life. The interpretations of the Scriptures are of two sorts: methodical, and solute or at large. For this divine water, which excelleth so much that of Jacob's well, is drawn forth much in the same kind, as natural water useth to be out of wells and fountains; either it is first forced up into a cistern, and from thence fetched and derived for use; or else it is drawn and received in buckets and vessels immediately where it springeth. The former sort whereof, though it seem to be the more ready, yet, in my judgment,

is more subject to corrupt. This is that method which hath exhibited unto us the scholastical divinity, whereby divinity hath been reduced into an art, as into a cistern, and the streams of doctrine or positions fetched and derived from thence.

In this men have sought three things, a summary brevity, a compacted strength, and a complete perfection; whereof the two first they fail to find, and the last they ought not to seek. For as to brevity, we see, in all summary methods, while men purpose to abridge, they give cause to dilate. For the sum, or abridgment, by contraction becometh obscure; the obscurity requireth exposition, and the exposition is deduced into large commentaries, or into common places and titles, which grow to be more vast than the original writings, whence the sum was at first extracted. So, we see, the volumes of the schoolmen are greater much than the first writings of the fathers, whence the master of the sentences made his sum or collection. So, in like manner, the volumes of the modern doctors of the civil law exceed those of the ancient jurisconsults, of which Trebonian compiled the digest. So as this course of sums and commentaries is that which doth infallibly make the body of sciences more immense in quantity, and more base in substance.

And for strength, it is true, that knowledges reduced into exact methods have a shew of strength, in that each part seemeth to support and sustain the other; but this is more satisfactory than substantial: like unto buildings which stand by architecture and compaction, which are more subject to ruin, than those that are built more strong in their several parts, though less compacted. But it is plain, that the more you recede from your grounds, the weaker do you conclude: and as in nature, the more you remove yourself from particulars, the greater peril of error you do incur; so much more in divinity, the more you recede from the Scriptures, by inferences and consequences, the more weak and dilute are your positions.

And as for perfection, or completeness in divinity, it is not to be sought; which makes this course of artificial divinity the more suspect. For he that will reduce a knowledge into an art, will make it round and uniform: but, in divinity, many things must be left abrupt and concluded with this: *O altitudo sapientiæ et scientiæ Dei! quam incomprehensibilia sunt judicia ejus, et non investigabiles viæ ejus?* So again the apostle saith *Ex parte scimus;* and to have the form of a total, where there is but matter for a part, cannot be without supplies by supposition and presumption. And therefore I conclude, that the true use of these sums and methods hath place in institutions or introductions preparatory unto knowledge; but in them, or by deducement from them, to handle the main body and substance of a knowledge, is in all sciences prejudicial, and in divinity dangerous.

As to the interpretation of the Scriptures solute and at large, there have been divers kinds introduced and devised; some of them rather curious and unsafe, than sober and warranted. Notwithstanding, thus much must be confessed, that the Scriptures being given by inspiration, and not by human reason, do differ from all other books in the author; which by consequence doth draw on some difference to be used by the expositor. For the inditer of them did know four things which no man attains to know; which are, the mysteries of the kingdom of glory, the perfection of the laws of nature, the secrets of the heart of man, and the future succession of all ages. For as to the first, it is said, *He that presseth into the light, shall be oppressed of the glory.* And again, *No man shall see my face and live.* To the second, *When he prepared the heavens I was present, when by law and compass he inclosed the deep.* To the third, *Neither was it needful that any should bear witness to him of man, for he knew well what was in man.* And to the last, *From the beginning are known to the Lord all his works.*

From the former of these two have been drawn certain senses and expositions of Scriptures, which

had need be contained within the bounds of sobriety; the one anagogical, and the other philosophical. But as to the former, man is not to prevent his time; *Videmus nunc per speculum in ænigmate, tunc autem facie ad faciem*; wherein, nevertheless, there seemeth to be a liberty granted, as far forth as the polishing of this glass, or some moderate explication of this enigma. But to press too far into it, cannot but cause a dissolution and overthrow of the spirit of man: for in the body there are three degrees of that we receive into it, aliment, medicine, and poison; whereof aliment is that which the nature of man can perfectly alter and overcome; medicine is that which is partly converted by nature, and partly converteth nature; and poison is that which worketh wholly upon nature, without that, that nature can in any part work upon it; so in the mind, whatsoever knowledge reason cannot at all work upon and convert, is a mere intoxication, and indangereth a dissolution of the mind and understanding.

But for the latter, it hath been extremely set on foot of late time by the school of Paracelsus, and some others, that have pretended to find the truth of all natural philosophy in the Scriptures; scandalizing and traducing all other philosophy as heathenish and profane. But there is no such enmity between God's word and his works; neither do they give honour to the Scriptures, as they suppose, but much imbase them. For to seek heaven and earth in the word of God, whereof it is said, *heaven and earth shall pass, but my word shall not pass*, is to seek temporary things amongst eternal; and as to seek divinity in philosophy, is to seek the living amongst the dead; so to seek philosophy in divinity, is to seek the dead amongst the living; neither are the pots or lavers, whose place was in the outward part of the temple, to be sought in the holiest place of all, where the ark of the testimony was seated. And again, the scope or purpose of the Spirit of God is not to express matters of nature in the Scriptures, otherwise than in passage, and for application to man's

capacity, and to matters moral or divine. And it is a true rule, *Auctoris aliud agentis parva auctoritas:* for it were a strange conclusion, if a man should use a similitude for ornament or illustration sake, borrowed from nature or history according to vulgar conceit, as of a basilisk, an unicorn, a centaur, a Briareus, an Hydra, or the like, that therefore he must needs be thought to affirm the matter thereof, positively to be true. To conclude therefore, these two interpretations, the one by reduction or enigmatical, the other philosophical or physical, which have been received and pursued in imitation of the rabbins and cabalists, are to be confined with a *noli altum sapere, sed time.*

But the two latter points, known to God, and unknown to man, touching the secrets of the heart, and the successions of time, do make a just and sound difference between the manner of the exposition of the Scriptures and all other books. For it is an excellent observation which hath been made upon the answers of our Saviour Christ to many of the questions which were propounded to him, how that they are impertinent to the state of the question demanded; the reason whereof is, because not being like man, which knows man's thoughts by his words, but knowing man's thoughts immediately, he never answered their words but their thoughts; much in the like manner it is with the Scriptures, which being written to the thoughts of men, and to the succession of all ages, with a foresight of all heresies, contradictions, differing estates of the church, yea and particularly of the elect, are not to be interpreted only according to the latitude of the proper sense of the place, and respectively towards that present occasion, whereupon the words were uttered, or in precise congruity or contexture with the words before or after, or in contemplation of the principal scope of the place; but have in themselves, not only totally or collectively, but distributively in clauses and words, infinite springs and streams of doctrine to water the church in every part: and therefore as the literal sense is, as it were,

the main stream or river, so the moral sense chiefly; and sometimes the allegorical or typical, are they whereof the church hath most use; not that I wish men to be bold in allegories, or indulgent or light in allusions; but that I do much condemn that interpretation of the Scripture, which is only after the manner as men use to interpret a profane book.

In this part, touching the exposition of the Scriptures, I can report no deficience; but by way of remembrance, this I will add, in perusing books of divinity, I find many books of controversies, and many of common places, and treatises, a mass of positive divinity as it is made an art; a number of sermons and lectures, and many prolix commentaries upon the Scriptures, with harmonies and concordances: but that form of writing in divinity, which in my judgment is of all others most rich and precious, is positive divinity, collected upon particular texts of Scriptures in brief observations, not dilated into common places; not chasing after controversies, not reduced into method of art; a thing abounding in sermons, which will vanish, but defective in books which will remain, and a thing wherein this age excelleth. For I am persuaded, and I may speak it with an *Absit invidia verbo*, and no ways in derogation of antiquity, but as in a good emulation between the vine and the olive, that if the choice and best of those observations upon texts of Scriptures, which have been made dispersedly in sermons within this your majesty's island of Britain, by the space of these forty years and more, leaving out the largeness of exhortations and applications thereupon, had been set down in a continuance, it had been the best work in divinity, which had been written since the apostles times.

The matter informed by divinity is of two kinds; matter of belief, and truth of opinion; and matter of service and adoration; which is also judged and directed by the former; the one being as the internal soul of religion, and the other as the external body thereof. And therefore the heathen religion was

not only a worship of idols, but the whole religion was an idol in itself, for it had no soul; that is, no certainty of belief or confession; as a man may well think, considering the chief doctors of their church were the poets: and the reason was, because the heathen gods were no jealous gods, but were glad to be admitted into part, as they had reason. Neither did they respect the pureness of heart, so they might have external honor and rites.

But out of these two do result and issue four main branches of divinity; faith, manners, liturgy, and government. Faith containeth the doctrine of the nature of God, of the attributes of God, and of the works of God. The nature of God consisteth of three persons in unity of Godhead. The attributes of God are either common to the Deity, or respective to the persons. The works of God summary are two, that of the creation, and that of the redemption; and both these works, as in total they appertain to the unity of the Godhead, so in their parts they refer to the three persons: that of the creation, in the mass of the matter, to the Father; in the disposition of the form, to the Son; and in the continuance and conservation of the being, to the Holy Spirit; so that of the redemption, in the election and counsel, to the Father; in the whole act and consummation to the Son; and in the application, to the Holy Spirit: for by the Holy Ghost was Christ conceived in flesh, and by the Holy Ghost are the elect regenerated in spirit. This work likewise we consider either effectually, in the elect; or privately, in the reprobate; or according to appearance, in the visible church.

For manners, the doctrine thereof is contained in the law, which discloseth sin. The law itself is divided, according to the edition thereof, into the law of nature, the law moral, and the law positive; and, according to the stile, into negative and affirmative, prohibitions and commandments. Sin, in the matter and subject thereof, is divided according to the commandments; in the form thereof, it referreth to the three persons in Deity. Sins of infirmity against the

Father, whose more special attribute is power; sins of ignorance against the Son, whose attribute is wisdom; and sins of malice against the Holy Ghost, whose attribute is grace or love. In the motions of it, it either moveth to the right hand or to the left, either to blind devotion, or to profane and libertine transgression; either in imposing restraint where God granteth liberty, or in taking liberty where God imposeth restraint. In the degrees and progress of it, it divideth itself into thought, word, or act. And in this part I commend much the deducing of the law of God to cases of conscience, for that I take indeed to be a breaking, and not exhibiting whole of the bread of life. But that which quickeneth both these doctrines of faith and manners, is the elevation and consent of the heart; whereunto appertain books of exhortation, holy meditation, christian resolution, and the like.

For the liturgy or service, it consisteth of the reciprocal acts between God and man; which, on the part of God, are the preaching of the word, and the sacraments, which are seals to the covenant, or as the visible word; and on the part of man, invocation of the name of God; and, under the law, sacrifices; which were as visible prayers or confessions; but now the adoration being *in spiritu et veritate*, there remaineth only *vituli labiorum*, although the use of holy vows of thankfulness and retribution may be accounted also as sealed petitions.

And for the government of the church, it consisteth of the patrimony of the church, the franchises of the church, and the offices and jurisdictions of the church, and the laws of the church directing the whole; all which have two considerations, the one in themselves, the other how they stand compatible and agreeable to the civil estate.

This matter of divinity is handled either in form of instruction of truth, or in form of confutation of falshood. The declinations from religion, besides the primitive, which is atheism, and the branches thereof, are three; heresies, idolatry, and witchcraft: he-

resies, when we serve the true God with a false worship; idolatry, when we worship false gods, supposing them to be true; and witchcraft, when we adore false gods, knowing them to be wicked and false. For so your majesty doth excellently well observe, that witchcraft is the height of idolatry. And yet we see though these be true degrees, Samuel teacheth us that they are all of a nature, when there is once a receding from the word of God; for so he saith, *Quasi peccatum ariolandi est repugnare, et quasi scelus idolatriæ nolle acquiescere.*

These things I have passed over so briefly, because I can report no deficiency concerning them: for I can find no space or ground that lieth vacant and unsown in the matter of divinity; so diligent have men been, either in sowing of good seed, or in sowing of tares.

Thus have I made as it were a small globe of the intellectual world, as truly and faithfully as I could discover, with a note and description of those parts which seem to me not constantly occupate, or not well converted by the labour of man. In which, if I have in any point receded from that which is commonly received, it hath been with a purpose of proceeding *in melius*, and not *in aliud:* a mind of amendment and proficience, and not of change and difference. For I could not be true and constant to the argument I handle, if I were not willing to go beyond others, but yet not more willing than to have others go beyond me again; which may the better appear by this, that I have propounded my opinions naked and unarmed, not seeking to preoccupate the liberty of mens judgments by confutations. For in any thing which is well set down, I am in good hope, that if the first reading move an objection, the second reading will make an answer. And in those things wherein I have erred, I am sure, I have not prejudiced the right by litigious arguments, which certainly have this contrary effect and operation, that they add authority to error, and destroy the authority

of that which is well invented. For question is an honor and preferment to falshood, as on the other side it is a repulse to truth. But the errors I claim and challenge to myself as my own. The good, if any be, is due *tanquam adeps sacrificii*, to be incensed to the honour first of the Divine Majesty, and next of your majesty, to whom on earth I am most bounden.

MAGNALIA NATURÆ,

PRÆCIPUE QUOAD USUS HUMANOS.

THE prolongation of life: the restitution of youth in some degree: the retardation of age: the curing of diseases counted incurable: the mitigation of pain: more easy and less loathsome purgings: the increasing of strength and activity: the increasing of ability to suffer torture or pain: the altering of complexions, and fatness and leanness: the altering of statures: the altering of features: the increasing and exalting of the intellectual parts: versions of bodies into other bodies: making of new species: transplanting of one species into another: instruments of destruction, as of war and poison: exhilaration of the spirits, and putting them in good disposition: force of the imagination, either upon another body, or upon the body itself: acceleration of time in maturations: acceleration of time in clarifications: acceleration of putrefaction: acceleration of decoction: acceleration of germination: making rich composts for the earth: impressions of the air, and raising of tempests: great alteration; as in induration, emollition, *etc.* turning crude and watry substances into oily and unctuous substances: drawing of new foods out of substances not now in use: making new threads for apparel; and new stuffs, such as paper, glass, *etc.* natural divinations: deceptions of the senses: greater pleasures of the senses: artificial minerals and cements.

SYLVA SYLVARUM:

OR, A

NATURAL HISTORY.

IN

TEN CENTURIES.

SYLVA SYLVARUM:

OR A

NATURAL HISTORY

OF

TREES AND TIMBER.

TO

THE READER.

HAVING had the honour to be continually with my lord in compiling of this work, and to be employed therein, I have thought it not amiss, with his lordship's good leave and liking, for the better satisfaction of those that shall read it, to make known somewhat of his lordship's intentions touching the ordering, and publishing of the same. I have heard his lordship often say, that if he should have served the glory of his own name, he had been better not to have published this Natural History: for it may seem an indigested heap of particulars, and cannot have that lustre, which books cast into methods have; but that he resolved to prefer the good of men, and that which might best secure it, before any thing that might have relation to himself. And he knew well, that there was no other way open to unloose mens minds, being bound, and, as it were, maleficiate, by the charms of deceiving notions and theories, and thereby made impotent for generation of works, but only no where to depart from the sense, and clear experience, but to keep close to it, especially in the beginning: besides, this Natural History was a debt of his, being designed and set down for a third part of the Instauration. *I have also heard his lordship discourse that men, no doubt, will think many of the experiments, contained in this collection, to be vulgar and trivial, mean and sordid, curious and fruitless: and therefore, he wisheth that they would have perpetually before their eyes what is now in doing, and*

the difference between this Natural History and others. For those Natural Histories which are extant, being gathered for delight and use, are full of pleasant descriptions and pictures, and affect and seek after admiration, rarities, and secrets. But, contrariwise, the scope, which his lordship intendeth, is to write such a Natural History, as may be fundamental to the erecting and building of a true philosophy, for the illumination of the understanding, the extracting of axioms, and the producing of many noble works and effects. For he hopeth by this means to acquit himself of that for which he taketh himself in a sort bound, and that is, the advancement of all learning and sciences. For, having in this present work collected the materials for the building, and in his Novum Organum, *of which his lordship is yet to publish a second part, set down the instruments and directions for the work; men shall now be wanting to themselves, if they raise not knowledge to that perfection whereof the nature of mortal men is capable. And in this behalf, I have heard his lordship speak complainingly, that his lordship, who thinketh he deserveth to be an architect in this building, should be forced to be a workman, and a labourer, and to dig the clay, and burn the brick; and, more than that, according to the hard condition of the Israelites at the latter end, to gather the straw and stubble over all the fields, to burn the bricks withal. For he knoweth, that except he do it, nothing will be done: men are so set to despise the means of their own good. And as for the baseness of many of the experiments; as long as they be God's works, they are honourable enough. And for the vulgarness of them, true axioms must be drawn from plain experience, and not from doubtful; and his lordship's course is to make wonders plain, and not plain things wonders; and that experience likewise must be broken and grinded,*

and not whole, or as it groweth. And for use; his lordship hath often in his mouth the two kinds of experiments; experimenta fructifera, *and* experimenta lûcifera: *experiments of use, and experiments of light: and he reporteth himself, whether he were not a strange man, that should think that light hath no use because it hath no matter. Further, his lordship thought good also to add unto many of the experiments themselves some gloss of the causes; that in the succeeding work of interpreting nature, and framing axioms, all things may be in more readiness. And for the causes hercin by him assigned; his lordship persuadeth himself, they are far more certain than those that are rendered by others; not for any excellency of his own wit, as his lordship is wont to say, but in respect of his continual conversation with nature and experience. He did consider likewise, that by this addition of causes, mens minds, which make so much haste to find out the causes of things, would not think themselves utterly lost in a vast wood of experience, but stay upon these causes, such as they are, a little, till true axioms may be more fully discovered. I have heard his lordship say also, that one great reason, why he would not put these particulars into any exact method, though he that looketh attentively into them shall find that they have a secret order, was, because he conceived that other men would now think that they could do the like; and so go on with a further collection: which, if the method had been exact, many would have despaired to attain by imitation. As for his lordship's love of order, I can refer any man to his lordship's latin book.* De Augmentis Scientiarum; *which, if my judgment be any thing, is written in the exactest order that I know any writing to be. I will conclude with an usual speech*

of his lordship's: That this work of his Natural History is the World as God made it, and not as men have made it; for that it hath nothing of imagination.

W. RAWLEY.

This epistle is the same, that should have been prefixed to this book, if his lordship had lived.

NATURAL HISTORY.

CENTURY I.

Experiments in consort, touching the straining and passing of bodies one through another; which they call Percolation.

DIG a pit upon the sea-shore, somewhat above the high-water mark; and sink it as deep as the low-water mark; and as the tide cometh in, it will fill with water, fresh and potable. This is commonly practised upon the coast of Barbary, where other fresh water is wanting. And Cæsar knew this well when he was besieged in Alexandria: for by digging of pits in the sea-shore, he did frustrate the laborious works of the enemies, which had turned the sea-water upon the wells of Alexandria; and so saved his army being then in desperation. But Cæsar mistook the cause, for he thought that all sea-sands had natural springs of fresh water: but it is plain, that it is the sea-water; because the pit filleth according to the measure of the tide; and the sea-water passing or straining through the sands, leaveth the saltness.

2. I REMEMBER to have read, that trial hath been made of salt-water passed through earth, through ten vessels, one within another; and yet it hath not lost its saltness, as to become potable: but the same man saith, that, by the relation of another, salt-water drained through twenty vessels hath become fresh. This experiment seemeth to cross that other of pits made by the sea-side; and yet but in part, if it be true that twenty repetitions do the effect. But it is worth the note, how poor the imitations of nature are in common course of experiments, except they be led by great judgment, and some good light of axioms. For first, there is no small difference between a passage of water through twenty small vessels, and

through such a distance, as between the low-water and high-water mark. Secondly, there is a great difference between earth and sand; for all earth hath in it a kind of nitrous salt, from which sand is more free; and besides, earth doth not strain the water so finely as sand doth. But there is a third point, that I suspect as much or more than the other two; and that is, that in the experiment of transmission of the sea-water into the pits, the water riseth; but in the experiment of transmission of the water through the vessels, it falleth. Now certain it is, that the salter part of water, once salted throughout, goeth to the bottom. And therefore no marvel, if the draining of water by descent doth not make it fresh: besides, I do somewhat doubt, that the very dashing of the water, that cometh from the sea, is more proper to strike off the salt part, than where the water slideth of its own motion.

3. It seemeth percolation, or transmission, which is commonly called straining, is a good kind of separation, not only of thick from thin, and gross from fine, but of more subtile natures; and varieth according to the body through which the transmission is made: as if through a woollen bag, the liquor leaveth the fatness; if through sand, the saltness, *etc.* They speak of severing wine from water, passing it through ivy wood, or through other the like porous body; but *non constat.*

4. The gum of trees, which we see to be commonly shining and clear, is but a fine passage or straining of the juice of the tree through the wood and bark. And in like manner, Cornish diamonds, and rock rubies, which are yet more resplendent than gums, are the fine exudations of stone.

5. Aristotle giveth the cause, vainly, why the feathers of birds are of more lively colours, than the hairs of beasts; for no beast hath any fine azure, or carnation, or green hair. He saith, it is because birds are more in the beams of the sun than beasts; but that is manifestly untrue; for cattle are more in the sun than birds, that live commonly in the woods, or in

some covert. The true cause is, that the excrementitious moisture of living creatures, which maketh as well the feathers in birds, as the hair in beasts, passeth in birds through a finer and more delicate strainer than it doth in beasts: for feathers pass through quills; and hair through skin.

6. The clarifying of liquors by adhesion, is an inward percolation; and is effected, when some cleaving body is mixed and agitated with the liquors; whereby the grosser part of the liquor sticks to that cleaving body; and so the finer parts are freed from the grosser. So the apothecaries clarify their syrups by whites of eggs, beaten with the juices which they would clarify; which whites of eggs gather all the dregs and grosser parts of the juice to them; and after the syrup being set on the fire, the whites of eggs themselves harden, and are taken forth. So hippocras is clarified by mixing with milk, and stirring it about, and then passing it through a woollen bag, which they call Hippocrates's Sleeve, and the cleaving nature of the milk draweth the powder of the spices, and grosser parts of the liquor to it; and in the passage they stick upon the woollen bag.

7. The clarifying of water is an experiment tending to health; besides the pleasure of the eye, when water is crystalline. It is effected by casting in and placing pebbles at the head of a current, that the water may strain through them.

8. It may be, percolation doth not only cause clearness and splendor, but sweetness of savour; for that also followeth as well as clearness, when the finer parts are severed from the grosser. So it is found, that the sweats of men, that have much heat, and exercise much, and have clean bodies, and fine skins, do smell sweet; as was said of Alexander; and we see that commonly gums have sweet odours.

Experiments in consort, touching motion of bodies upon their pressure.

9. Take a glass, and put water into it, and wet your finger, and draw it round about the lip of the

glass, pressing it somewhat hard; and after you have drawn it some few times about, it will make the water frisk and sprinkle up in a fine dew. This instance doth excellently demonstrate the force of compression in a solid body: for whensoever a solid body, as wood, stone, metal, *etc.* is pressed, there is an inward tumult in the parts thereof, seeking to deliver themselves from the compression: and this is the cause of all violent motion. Wherein it is strange in the highest degree, that this motion hath never been observed, nor inquired; it being of all motions the most common, and the chief root of all mechanical operations. This motion worketh in round at first, by way of proof and search which way to deliver itself: and then worketh in progress, where it findeth the deliverance easiest. In liquors this motion is visible; for all liquors strucken make round circles, and withal dash; but in solids, which break not, it is so subtile, as it is invisible; but nevertheless bewrayeth itself by many effects; as in this instance whereof we speak. For the pressure of the finger, furthered by the wetting, because it sticketh so much the better unto the lip of the glass, after some continuance, putteth all the small parts of the glass into work; that they strike the water sharply; from which percussion that sprinkling cometh.

10. If you strike or pierce a solid body that is brittle, as glass, or sugar, it breaketh not only where the immediate force is; but breaketh all about into shivers and fitters; the motion, upon the pressure, searching all ways, and breaking where it findeth the body weakest.

11. The powder in shot, being dilated into such a flame as endureth not compression, moveth likewise in round, the flame being in the nature of a liquid body, sometimes recoiling, sometimes breaking the piece, but generally discharging the bullet, because there it findeth easiest deliverance.

12. This motion upon pressure, and the reciprocal thereof, which is motion upon tensure, we use to call by one common name, motion of liberty; which is,

when any body, being forced to a preternatural extent or dimension, delivereth and restoreth itself to the natural: as when a blown bladder, pressed, riseth again; or when leather or cloth tentured, spring back. These two motions, of which there be infinite instances, we shall handle in due place.

13. This motion upon pressure is excellently also demonstrated in sounds; as when one chimeth upon a bell, it soundeth; but as soon as he layeth his hand upon it, the sound ceaseth: and so the sound of a virginal string, as soon as the quill of the jack falleth from it, stoppeth. For these sounds are produced by the subtile percussion of the minute parts of the bell, or string, upon the air; all one, as the water is caused to leap by the subtile percussion of the minute parts of the glass, upon the water, whereof we spake a little before in the ninth experiment. For you must not take it to be the local shaking of the bell, or string, that doth it: as we shall fully declare, when we come hereafter to handle sounds.

Experiments in consort, touching separations of bodies by weight.

14. Take a glass with a belly and a long neb; fill the belly, in part, with water: take also another glass, where into put claret wine and water mingled; reverse the first glass, with the belly upwards, stopping the neb with your finger; then dip the mouth of it within the second glass, and remove your finger: continue it in that posture for a time; and it will unmingle the wine from the water: the wine ascending and settling in the top of the upper glass; and the water descending and settling in the bottom of the lower glass. The passage is apparent to the eye; for you shall see the wine, as it were, in a small vein, rising through the water. For handsomeness sake, because the working requireth some small time, it were good you hang the upper glass upon a nail. But as soon as there is gathered so much pure and unmixed water in the bottom of the lower glass, as that the mouth of the upper glass dippeth into it, the motion ceaseth.

15. Let the upper glass be wine, and the lower water; there followeth no motion at all. Let the upper glass be water pure, the lower water coloured, or contrariwise, there followeth no motion at all. But it hath been tried, that though the mixture of wine and water, in the lower glass, be three parts water and but one wine, yet it doth not dead the motion. This separation of water and wine appeareth to be made by weight; for it must be of bodies of unequal weight, or else it worketh not; and the heavier body must ever be in the upper glass. But then note withal, that the water being made pensile, and there being a great weight of water in the belly of the glass, sustained by a small pillar of water in the neck of the glass, it is that which setteth the motion on work: for water and wine in one glass, with long standing, will hardly sever.

16. This experiment would be extended from mixtures of several liquors, to simple bodies which consist of several similar parts: try it therefore with brine or salt-water, and fresh-water; placing the salt-water, which is the heavier, in the upper-glass; and see whether the fresh will come above. Try it also with water thick sugared, and pure water; and see whether the water, which cometh above, will lose its sweetness: for which purpose it were good there were a little cock made in the belly of the upper glass.

Experiments in consort, touching judicious and accurate infusions, both in liquors and air.

17. In bodies containing fine spirits, which do easily dissipate, when you make infusions, the rule is; a short stay of the body in the liquor, receiveth the spirit; and a longer stay, confoundeth it; because it draweth forth the earthy part withal, which embaseth the finer. And therefore it is an error in physicians, to rest simply upon the length of stay for increasing the virtue. But if you will have the infusion strong, in those kinds of bodies which have fine spirits, your way is not to give longer time, but to repeat the infusion

of the body oftener. Take violets, and infuse a good pugil of them in a quart of vinegar; let them stay three quarters of an hour, and take them forth, and refresh the infusion with like quantity of new violets, seven times; and it will make a vinegar so fresh of the flower, as if, a twelvemonth after, it be brought you in a saucer, you shall smell it before it come at you. Note, that it smelleth more perfectly of the flower a good while after, than at first.

18. This rule, which we have given, is of singular use for the preparations of medicines, and other infusions. As for example: the leaf of burrage hath an excellent spirit to repress the fuliginous vapour of dusky melancholy, and so to cure madness: but nevertheless if the leaf be infused long it yieldeth forth but a raw substance, of no virtue: therefore I suppose, that if in the must of wine, or wort of beer, while it worketh, before it be tunned, the burrage stay a small time, and be often changed with fresh; it will make a sovereign drink for melancholy passions. And the like I conceive of orange flowers.

19. Rhubarb hath manifestly in it parts of contrary operations: parts that purge; and parts that bind the body: and the first lie looser, and the latter lie deeper: so that if you infuse rhubarb for an hour, and crush it well, it will purge better, and bind the body less after the purging, than if it had stood twenty-four hours; this is tried: but I conceive likewise, that by repeating the infusion of rhubarb, several times, as was said of violets, letting each stay in but a small time; you may make it as strong a purging medicine as scammony. And it is not a small thing won in physic, if you can make rhubarb, and other medicines that are benedict, as strong purgers as those that are not, without some malignity.

20. Purging medicines, for the most part, have their purgative virtue in a fine spirit; as appeareth by that they endure not boiling without much loss of virtue. And therefore it is of good use in physic, if you can retain the purging virtue, and take away the unpleasant taste of the purger; which it is like

you may do, by this course of infusing oft, with little stay. For it is probable that the horrible and odious taste is in the grosser part.

21. Generally, the working by infusions is gross and blind, except you first try the issuing of the several parts of the body, which of them issue more speedily, and which more slowly; and so by apportioning the time, can take and leave that quality which you desire. This to know there are two ways; the one to try what long stay, and what short stay worketh, as hath been said; the other to try in order the succeeding infusions of one and the same body, successively, in several liquors. As for example; take orange pills, or rosemary, or cinnamon, or what you will; and let them infuse half an hour in water: then take them out, and infuse them again in other water; and so the third time: and then taste and consider the first water, the second, and the third: and you will find them differing, not only in strength and weakness, but otherwise in taste or odour; for it may be the first water will have more of the scent, as more fragrant; and the second more of the taste, as more bitter or biting, *etc.*

22. Infusions in air, for so we may well call odours, have the same diversities with infusions in water; in that the several odours, which are in one flower, or other body, issue at several times; some earlier, some later; so we find that violets, woodbines, strawberries, yield a pleasing scent, that cometh forth first; but soon after an ill scent quite differing from the former. Which is caused, not so much by mellowing, as by the late issuing of the grosser spirit.

23. As we may desire to extract the finest spirits in some cases; so we may desire also to discharge them, as hurtful, in some other. So wine burnt, by reason of the evaporating of the finer spirit, inflameth less, and is best in agues: opium loseth some of its poisonous quality, if it be vapoured out, mingled with spirit of wine, or the like: sena loseth somewhat of its windiness by decocting; and, generally, subtile or windy spirits are taken off by incension or eva-

poration. And even in infusions in things that are of too high a spirit, you were better pour off the first infusion, after a small time, and use the latter.

Experiment solitary touching the appetite of continuation in liquids.

24. Bubbles are in the form of an hemisphere; air within and a little skin of water without: and it seemeth somewhat strange, that the air should rise so swiftly, while it is in the water; and when it cometh to the top, should be stayed by so weak a cover as that of the bubble is. But as for the swift ascent of the air, while it is under the water, that is a motion of percussion from the water; which itself descending driveth up the air; and no motion of levity in the air. And this Democritus called *motus plagæ*. In this common experiment, the cause of the inclosure of the bubble is, for that the appetite to resist separation, or discontinuance, which in solid bodies is strong, is also in liquors, though fainter and weaker; as we see in this of the bubble: we see it also in little glasses of spittle that children make of rushes; and in castles of bubbles, which they make by blowing into water, having obtained a little degree of tenacity by mixture of soap: we see it also in the stillicides of water, which if there be water enough to follow, will draw themselves into a small thread, because they will not discontinue; but if there be no remedy, then they cast themselves into round drops; which is the figure that saveth the body most from discontinuance: the same reason is of the roundness of the bubble, as well for the skin of water, as for the air within: for the air likewise avoideth discontinuance; and therefore casteth itself into a round figure. And for the stop and arrest of the air a little while, it sheweth that the air of itself hath little or no appetite of ascending.

Experiment solitary touching the making of artificial springs.

25. The rejection, which I continually use, of experiments, though it appeareth not, is infinite; but yet if an experiment be probable in the work, and of great use, I receive it, but deliver it as doubtful. It was reported by a sober man, that an artificial spring may be made thus: Find out a hanging ground, where there is a good quick fall of rain-water. Lay a half-trough of stone, of a good length, three or four foot deep within the same ground; with one end upon the high ground, the other upon the low. Cover the trough with brakes a good thickness, and cast sand upon the top of the brakes: you shall see, saith he, that after some showers are past, the lower end of the trough will run like a spring of water: which is no marvel, if it hold while the rain-water lasteth; but he said it would continue long time after the rain is past: as if the water did multiply itself upon the air, by the help of the coldness and condensation of the earth, and the consort of the first water.

Experiment solitary touching the venomous quality of man's flesh.

26. The French, who put off the name of the French disease unto the name of the disease of Naples, do report, that at the siege of Naples, there were certain wicked merchants that barrelled up man's flesh, of some that had been lately slain in Barbary, and sold it for tunney; and that upon that foul and high nourishment, was the original of that disease. Which may well be, for that it is certain, that the cannibals in the West-Indies eat man's flesh; and the West-Indies were full of the pox when they were first discovered: and at this day the mortalest poisons, practised by the West-Indians, have some mixture of the blood, or fat, or flesh of man: and divers witches and sorceresses, as well amongst the heathen, as amongst the christians, have fed upon man's flesh, to aid, as it seemeth, their imagination, with high and foul vapours.

Experiment solitary touching the version and transmutation of air into water.

27. It seemeth that there be these ways, in likelihood, of version of vapours or air, into water and moisture. The first is cold; which doth manifestly condense; as we see in the contracting of the air in the weather-glass; whereby it is a degree nearer to water. We see it also in the generation of springs, which the ancients thought, very probably, to be made by the version of air into water, holpen by the rest, which the air hath in those parts; whereby it cannot dissipate. And by the coldness of rocks; for there springs are chiefly generated. We see it also in the effects of the cold of the middle region, as they call it, of the air: which produceth dews and rains. And the experiment of turning water into ice, by snow, nitre, and salt, whereof we shall speak hereafter, would be transferred to the turning of air into water. The second way is by compression; as in stillatories, where the vapour is turned back upon itself, by the encounter of the sides of the stillatory; and in the dew upon the covers of boiling pots; and in the dew towards rain, upon marble and wainscot. But this is like to do no great effect; except it be upon vapours, and gross air, that are already very near in degree to water. The third is that, which may be searched into, but doth not yet appear; which is, by mingling of moist vapours with air; and trying if they will not bring a return of more water, than the water was at first: for if so, that increase is a version of the air: therefore put water into the bottom of a stillatory, with the neb stopped; weigh the water first; hang in the middle of the stillatory a large spunge; and see what quantity of water you can crush out of it; and what it is more or less, compared with the water spent; for you must understand, that if any version can be wrought, it will be easiliest done in small pores: and that is the reason why we prescribe a spunge. The fourth way is probable also, though not appearing; which is, by receiving the air

into the small pores of bodies: for, as hath been said, every thing in small quantity is more easy for version; and tangible bodies have no pleasure in the consort of air, but endeavour to subact it into a more dense body: but in intire bodies it is checked; because if the air should condense, there is nothing to succeed: therefore it must be in loose bodies, as sand, and powder; which, we see, if they lie close, of themselves gather moisture.

Experiment solitary touching helps towards the beauty and good features of persons.

28. It is reported by some of the ancients; that whelps, or other creatures, if they be put young into such a cage or box, as they cannot rise to their stature, but may increase in breadth or length, will grow accordingly as they can get room: which if it be true and feasible, and that the young creature so pressed and straitened, doth not thereupon die; it is a means to produce dwarf creatures, and in a very strange figure. This is certain, and noted long since; that the pressure or forming of the parts of creatures, when they are very young, doth alter the shape not a little; as the stroking of the heads of infants, between the hands, was noted of old, to make *Macrocephali;* which shape of the head, at that time, was esteemed. And the raising gently of the bridge of the nose, doth prevent the deformity of a saddle nose. Which observation well weighed, may teach a means to make the persons of men and women, in many kinds, more comely and better featured than otherwise they would be; by the forming and shaping of them in their infancy: as by stroking up the calves of the legs, to keep them from falling down too low; and by stroking up the forehead, to keep them from being low-foreheaded. And it is a common practice to swathe infants, that they may grow more straight and better shaped: and we see young women, by wearing strait bodice, keep themselves from being gross and corpulent.

Experiment solitary touching the condensing of air in such sort as it may put on weight, and yield nourishment.

29. Onions, as they hang, will many of them shoot forth; and so will penny-royal; and so will an herb called orpin; with which they use in the country to trim their houses, binding it to a lath or stick, and setting it against a wall. We see it likewise, more especially, in the greater semper-vive, which will put out branches, two or three years: but it is true, that commonly they wrap the root in a cloth besmeared with oil, and renew it once in half a year. The like is reported by some of the ancients, of the stalks of lilies. The cause is; for that these plants have a strong, dense, and succulent moisture, which is not apt to exhale; and so is able, from the old store, without drawing help from the earth, to suffice the sprouting of the plant: and this sprouting is chiefly in the late spring, or early summer; which are the times of putting forth. We see also, that stumps of trees lying out of the ground, will put forth sprouts for a time. But it is a noble trial, and of very great consequence, to try whether these things in the sprouting, do increase weight; which must be tried, by weighing them before they be hanged up; and afterwards again, when they are sprouted. For if they increase not in weight, then it is no more but this; that what they send forth in the sprout, they lose in some other part: but if they gather weight, then it is *magnale naturæ;* for it sheweth that air may be made so to be condensed, as to be converted into a dense body; whereas the race and period of all things, here above the earth, is to extenuate and turn things to be more pneumatical and rare; and not to be retrograde, from pneumatical to that which is dense. It sheweth also, that air can nourish; which is another great matter of consequence. Note, that to try this, the experiment of the semper-vive must be made without oiling the cloth; for else, it may be, the plant receiveth nourishment from the oil.

Experiment solitary touching the commixture of flame and air, and the great force thereof.

30. Flame and air do not mingle, except it be in an instant; or in the vital spirits of vegetables and living creatures. In gun-powder, the force of it hath been ascribed to rarefaction of the earthly substance into flame; and thus far it is true: and then, forsooth, it is become another element; the form whereof occupieth more place; and so, of necessity, followeth a dilatation: and therefore, lest two bodies should be in one place, there must needs also follow an expulsion of the pellet; or blowing up of the mine. But these are crude and ignorant speculations. For flame, if there were nothing else, except it were in very great quantity, will be suffocate with any hard body, such as a pellet is; or the barrel of a gun; so as the flame would not expel the hard body; but the hard body would kill the flame, and not suffer it to kindle or spread. But the cause of this so potent a motion, is the nitre, which we call otherwise saltpetre, which having in it a notable crude and windy spirit, first by the heat of the fire suddenly dilateth itself; and we know that simple air, being preternaturally attenuated by heat, will make itself room, and break and blow up that which resisteth it; and secondly, when the nitre hath dilated itself, it bloweth abroad the flame, as an inward bellows. And therefore we see that brimstone, pitch, camphire, wild-fire, and divers other inflammable matters, though they burn cruelly, and are hard to quench, yet they make no such fiery wind as gun-powder doth: and on the other side, we see that quick-silver, which is a most crude and watry body, heated and pent in, hath the like force with gun-powder. As for living creatures, it is certain, their vital spirits are a substance compounded of an airy and flamy matter; and though air and flame being free, will not well mingle; yet bound in by a body that hath some fixing, they will. For that you may best see in those two bodies, which are their aliments, water and oil; for they likewise will not well mingle of themselves; but in

the bodies of plants, and living creatures, they will. It is no marvel therefore, that a small quantity of spirits, in the cells of the brain and canals of the sinews, are able to move the whole body, which is of so great mass, both with so great force, as in wrestling, leaping; and with so great swiftness, as in playing division upon the lute. Such is the force of these two natures, air and flame, when they incorporate.

Experiment solitary touching the secret nature of flame.

31. Take a small wax candle, and put it in a socket of brass or iron; then set it upright in a porringer full of spirit of wine heated: then set both the candle and spirit of wine on fire, and you shall see the flame of the candle open itself, and become four or five times bigger than otherwise it would have been; and appear in figure globular, and not in pyramis. You shall see also, that the inward flame of the candle keepeth colour, and doth not wax any whit blue towards the colour of the outward flame of the spirit of wine. This is a noble instance; wherein two things are most remarkable: the one, that one flame within another quencheth not; but is a fixed body, and continueth as air or water do. And therefore flame would still ascend upwards in one greatness, if it were not quenched on the sides: and the greater the flame is at the bottom the higher is the rise. The other, that flame doth not mingle with flame, as air doth with air, or water with water, but only remaineth contiguous; as it cometh to pass betwixt consisting bodies. It appeareth also that the form of a pyramis in flame, which we usually see, is merely by accident, and that the air about, by quenching the sides of the flame, crusheth it, and extenuateth it into that form; for of itself it would be round; and therefore smoke is in the figure of a pyramis reversed; for the air quencheth the flame, and receiveth the smoke. Note also, that the flame of the candle, within the flame of the spirit of wine, is troubled; and doth not only open and move up-

wards, but moveth waving to and fro; as if flame of its own nature, if it were not quenched, would roll and turn, as well as move upwards. By all which it should seem, that the celestial bodies, most of them, are true fires or flames, as the Stoics held; more fine, perhaps, and rarified than our flame is. For they are all globular and determinate; they have rotation; and they have the colour and splendor of flame: so that flame above is durable, and consistent, and in its natural place; but with us it is a stranger, and momentary, and impure; like Vulcan that halted with his fall.

Experiment solitary touching the different force of flame in the midst and on the sides.

32. Take an arrow, and hold it in flame for the space of ten pulses, and when it cometh forth, you shall find those parts of the arrow which were on the outsides of the flame more burned, blacked, and turned almost into a coal, whereas that in the midst of the flame will be as if the fire had scarce touched it. This is an instance of great consequence for the discovery of the nature of flame; and sheweth manifestly, that flame burneth more violently towards the sides than in the midst: and, which is more, that heat or fire is not violent or furious, but where it is checked and pent up. And therefore the Peripatetics, howsoever their opinion of an element of fire above the air is justly exploded, in that point they acquit themselves well: for being opposed, that if there were a sphere of fire, that encompassed the earth so near hand, it were impossible but all things should be burnt up; they answer, that the pure elemental fire, in its own place, and not irritated, is but of a moderate heat.

Experiment solitary touching the decrease of the natural motion of gravity, in great distance from the earth; or within some depth of the earth.

33. It is affirmed constantly by many, as an usual experiment; that a lump of ore, in the bottom of a

mine, will be tumbled and stirred by two mens strength; which if you bring it to the top of the earth, will ask six mens strength at the least to stir it. It is a noble instance, and is fit to be tried to the full; for it is very probable, that the motion of gravity worketh weakly, both far from the earth, and also within the earth: the former, because the appetite of union of dense bodies with the earth, in respect of the distance, is more dull; the latter, because the body hath in part attained its nature when it is some depth in the earth. For as for the moving to a point or place, which was the opinion of the ancients, it is a mere vanity.

Experiment solitary touching the contraction of bodies in bulk, by the mixture of the more liquid body with the more solid.

34. It is strange how the ancients took up experiments upon credit, and yet did build great matters upon them. The observation of some of the best of them, delivered confidently, is, that a vessel filled with ashes will receive the like quantity of water, that it would have done if it had been empty. But this is utterly untrue, for the water will not go in by a fifth part. And I suppose, that that fifth part is the difference of the lying close, or open, of the ashes; as we see that ashes alone, if they be hard pressed, will lie in less room: and so the ashes with air between, lie looser; and with water, closer. For I have not yet found certainly, that the water itself, by mixture of ashes or dust, will shrink or draw into less room.

Experiment solitary touching the making vines more fruitful.

35. It is reported of credit, that if you lay good store of kernels of grapes about the root of a vine, it will make the vine come earlier and prosper better. It may be tried with other kernels laid about the root of a plant of the same kind; as figs, kernels of apples, *etc.* The cause may be, for that the kernels draw out

of the earth juice fit to nourish the tree, as those that would be trees of themselves, though there were no root; but the root being of greater strength robbeth and devoureth the nourishment, when they have drawn it: as great fishes devour little.

Experiments in consort touching purging medicines.

36. The operation of purging medicines, and the causes thereof, have been thought to be a great secret, and so according to the slothful manner of men, it is referred to a hidden propriety, a specifical virtue, and a fourth quality, and the like shifts of ignorance. The causes of purging are divers: all plain and perspicuous; and throughly maintained by experience. The first is, that whatsoever cannot be overcome and digested by the stomach, is by the stomach either put up by vomit, or put down to the guts; and by that motion of expulsion in the stomach and guts, other parts of the body, as the orifices of the veins, and the like, are moved to expel by consent. For nothing is more frequent than motion of consent in the body of man. This surcharge of the stomach is caused either by the quality of the medicine, or by the quantity. The qualities are three: extreme bitter, as in aloes, coloquintida, *etc.* lothsome and of horrible taste, as in agaric, black hellebore, *etc.* and of secret malignity, and disagreement towards man's body, many times not appearing much in the taste, as in scammony, mechoachan, antimony, *etc.* And note well, that if there be any medicine that purgeth, and hath neither of the first two manifest qualities, it is to be held suspected as a kind of poison; for that it worketh either by corrosion, or by a secret malignity, and enmity to nature: and therefore such medicines are warily to be prepared and used. The quantity of that which is taken doth also cause purging; as we see in a great quantity of new milk from the cow; yea and a great quantity of meat; for surfeits many times turn to purges, both upwards and downwards. Therefore we see generally, that the working of purging medicines cometh two or three hours after the medicines

taken; for that the stomach first maketh a proof, whether it can concoct them. And the like happeneth after surfeits, or milk in too great quantity.

37. A SECOND cause is mordication of the orifices of the parts; especially of the mesentery veins; as it is seen, that salt, or any such thing that is sharp and biting, put into the fundament, doth provoke the part to expel; and mustard provoketh sneezing: and any sharp thing to the eyes provoketh tears. And therefore we see that almost all purgers have a kind of twitching and vellication, besides the griping which cometh of wind. And if this mordication be in an over-high degree, it is little better than the corrosion of poison; as it cometh to pass sometimes in antimony, especially if it be given to bodies not replete with humours; for where humours abound, the humours save the parts.

38. THE third cause is attraction: for I do not deny, but that purging medicines have in them a direct force of attraction; as drawing plaisters have in surgery: and we see sage or betony bruised, sneezing powder, and other powders or liquors which the physicians call *errhines*, put into the nose, draw phlegm and water from the head; and so it is in apophlegmatisms and gargarisms, that draw the rheum down by the palate. And by this virtue, no doubt, some purgers draw more one humour, and some another, according to the opinion received: as rhubarb draweth choler: sena melancholy: agaric phlegm, *etc.* but yet, more or less, they draw promiscuously. And note also, that besides sympathy between the purger and the humour, there is also another cause, why some medicines draw some humour more than another. And it is, for that some medicines work quicker than others: they that draw quick, draw only the lighter and more fluid humours; and they that draw slow, work upon the more tough and viscous humours, And therefore men must beware how they take rhubarb, and the like, alone familiarly; for it taketh only the lightest part of the humour away, and leaveth the

mass of humours more obstinate. And the like may be said of wormwood, which is so much magnified.

39. The fourth cause is flatuosity; for wind stirred moveth to expel: and we find that in effect all purgers have in them a raw spirit or wind; which is the principal cause of tortion in the stomach and belly. And therefore purgers lose most of them, the virtue, by decoction upon the fire; and for that cause are given chiefly in infusion, juice, or powder.

40. The fifth cause is compression or crushing: as when water is crushed out of a spunge: so we see that taking cold moveth looseness by contraction of the skin and outward parts; and so doth cold likewise cause rheums, and defluxions from the head; and some astringent plaisters crush out purulent matter. This kind of operation is not found in many medicines; myrobalanes have it; and it may be the barks of peaches; for this virtue requireth an astriction; but such an astriction as is not grateful to the body; for a pleasing astriction doth rather bind in the humours than expel them: and therefore, such astriction is found in things of an harsh taste.

41. The sixth cause is lubrefaction and relaxation. As we see in medicines emollient; such as are milk, honey, mallows, lettice, mercurial, pellitory of the wall, and others. There is also a secret virtue of relaxation in cold: for the heat of the body bindeth the parts and humours together, which cold relaxeth: as it is seen in urine, blood, pottage, or the like; which, if they be cold, break and dissolve. And by this kind of relaxation, fear looseneth the belly; because the heat retiring inwards towards the heart, the guts, and other parts are relaxed; in the same manner as fear also causeth trembling in the sinews. And of this kind of purgers are some medicines made of mercury.

42. The seventh cause is abstertion: which is plainly a scouring off, or incision of the more viscous humours, and making the humours more fluid; and cutting between them and the part; as is found in nitrous water, which scoureth linen cloth speedily

from the foulness. But this incision must be by a sharpness, without astriction: which we find in salt, wormwood, oxymel, and the like.

43. There be medicines that move stools, and not urine; some other, urine, and not stools. Those that purge by stool, are such as enter not at all, or little into the mesentery veins; but either at the first are not digestible by the stomach, and therefore move immediately downwards to the guts; or else are afterwards rejected by the mesentery veins; and so turn likewise downwards to the guts; and of these two kinds are most purgers. But those that move urine, are such as are well digested of the stomach, and well received also of the mesentery veins; so they come as far as the liver, which sendeth urine to the bladder, as the whey of blood: and those medicines being opening and piercing, do fortify the operation of the liver, in sending down the wheyey part of the blood to the reins. For medicines urinative do not work by rejection and indigestion, as solutive do.

44. There be divers medicines, which in greater quantity move stool, and in smaller urine: and so contrariwise, some that in greater quantity move urine, and in smaller stools. Of the former sort is rhubarb, and some others. The cause is, for that rhubarb is a medicine which the stomach in a small quantity doth digest and overcome, being not flatuous nor lothsome, and so sendeth it to the mesentery veins; and so being opening, it helpeth down urine: but in a greater quantity, the stomach cannot overcome it, and so it goeth to the guts. Pepper by some of the ancients is noted to be of the second sort; which being in small quantity, moveth wind in the stomach and guts, and so expelleth by stool; but being in greater quantity, dissipateth the wind, and itself getteth to the mesentery veins, and so to the liver and reins; where, by heating and opening, it sendeth down urine more plentifully.

Experiments in consort touching meats and drinks that are most nourishing.

45. We have spoken of evacuating of the body; we will now speak something of the filling of it by restoratives in consumptions and emaciating diseases. In vegetables, there is one part that is more nourishing than another; as grains and roots nourish more than the leaves; insomuch as the order of the Foliatanes was put down by the pope, as finding leaves unable to nourish man's body. Whether there be that difference in the flesh of living creatures, is not well inquired: as whether livers and other entrails, be not more nourishing than the outward flesh. We find that amongst the Romans, a goose's liver was a great delicacy; insomuch as they had artificial means to make it fair and great; but whether it were more nourishing appeareth not. It is certain, that marrow is more nourishing than fat. And I conceive that some decoction of bones and sinews, stamped and well strained, would be a very nourishing broth: we find also that Scotch skinck, which is a pottage of strong nourishment, is made with the knees and sinews of beef, but long boiled: jelly also, which they use for a restorative, is chiefly made of knuckles of veal. The pulp that is within the crawfish or crab, which they spice and butter, is more nourishing than the flesh of the crab or crawfish. The yolks of eggs are clearly more nourishing than the whites. So that it should seem, that the parts of living creatures that lie more inwards, nourish more than the outward flesh; except it be the brain: which the spirits prey too much upon, to leave it any great virtue of nourishment. It seemeth for the nourishing of aged men, or men in consumptions, some such thing should be devised, as should be half chylus, before it be put into the stomach.

46. Take two large capons; parboil them upon a soft fire, by the space of an hour or more, till in effect all the blood be gone. Add in the decoction the peel of a sweet lemon, or a good part of the peel of a citron, and a little mace. Cut off the shanks, and throw them away. Then with a good strong chop-

ping knife mince the two capons, bones and all, as small as ordinary minced meat; put them into a large neat boulter; then take a kilderkin, sweet and well seasoned, of four gallons of beer, of 8s. strength, new as it cometh from the tunning; make in the kilderkin a great bung-hole of purpose: then thrust into it the boulter, in which the capons are, drawn out in length; let it steep in it three days and three nights, the bung-hole open, to work; then close the bung-hole, and so let it continue a day and a half; then draw it into bottles, and you may drink it well after three days bottling; and it will last six weeks, approved. It drinketh fresh, flowereth and mantleth exceedingly; it drinketh not newish at all; it is an excellent drink for a consumption, to be drunk either alone, or carded with some other beer. It quencheth thirst, and hath no whit of windiness. Note, that it is not possible, that meat and bread, either in broths or taken with drink, as is used, should get forth into the veins and outward parts, so finely and easily, as when it is thus incorporate, and made almost a chylus aforehand.

47. Trial would be made of the like brew with potatoe roots, or burr roots, or the pith of artichokes, which are nourishing meats: it may be tried also with other flesh; as pheasant, partridge, young pork, pig, venison, especially of young deer, *etc.*

48. A mortress made with the brawn of capons, stamped and strained, and mingled, after it is made, with like quantity, at the least, of almond butter, is an excellent meat to nourish those that are weak; better than blackmanger, or jelly: and so is the cullice of cocks, boiled thick with the like mixture of almond butter: for the mortress or cullice, of itself, is more savoury and strong, and not so fit for nourishing of weak bodies; but the almonds, that are not of so high a taste as flesh, do excellently qualify it.

49. Indian maiz hath, of certain, an excellent spirit of nourishment; but it must be thoroughly boiled, and made into a maiz-cream like a barley-cream. I judge the same of rice, made into a cream; for rice is in

Turkey, and other countries of the east, most fed upon; but it must be thoroughly boiled in respect of the hardness of it, and also because otherwise it bindeth the body too much.

50. Pistachoes, so they be good, and not musty, joined with almonds in almond milk; or made into a milk of themselves, like unto almond milk, but more green, are an excellent nourisher: but you shall do well, to add a little ginger, scraped, because they are not without some subtile windiness.

51. Milk warm from the cow, is found to be a great nourisher, and a good remedy in consumptions: but then you must put into it, when you milk the cow, two little bags; the one of powder of mint, the other of powder of red roses; for they keep the milk somewhat from turning or curdling in the stomach; and put in sugar also for the same cause, and partly for the taste's sake; but you must drink a good draught, that it may stay less time in the stomach, lest it curdle: and let the cup into which you milk the cow, be set in a greater cup of hot water, that you may take it warm. And cow milk thus prepared, I judge to be better for a consumption, than ass milk, which, it is true, turneth not so easily, but it is a little harsh; marry it is more proper for sharpness of urine, and exulceration of the bladder, and all manner of lenifyings. Woman's milk likewise is prescribed, when all fail; but I commend it not, as being a little too near the juice of man's body, to be a good nourisher; except it be in infants, to whom it is natural.

52. Oil of sweet almonds, newly drawn, with sugar, and a little spice, spread upon bread toasted, is an excellent nourisher: but then to keep the oil from frying in the stomach, you must drink a good draught of mild beer after it; and to keep it from relaxing the stomach too much, you must put in a little powder of cinnamon.

53. The yolks of eggs are of themselves so well prepared by nature for nourishment, as, so they be poached, or rare boiled, they need no other preparation or mixture; yet they may be taken also raw,

when they are new laid, with Malmsey, or sweet wine; you shall do well to put in some few slices of eryngium roots, and a little ambergrice; for by this means, besides the immediate faculty of nourishment, such drink will strengthen the back, so that it will not draw down the urine too fast; for too much urine doth always hinder nourishment.

54. Mincing of meat, as in pies, and buttered minced meat, saveth the grinding of the teeth; and therefore, no doubt, it is more nourishing, especially in age, or to them that have weak teeth; but the butter is not so proper for weak bodies; and therefore it were good to moisten it with a little claret wine, peel of lemon or orange, cut small, sugar, and a very little cinnamon or nutmeg. As for chuets, which are likewise minced meat, instead of butter and fat, it were good to moisten them, partly with cream, or almond, or pistacho milk; or barley, or maiz-cream; adding a little coriander seed and caraway seed, and a very little saffron. The more full handling of alimentation we reserve to the due place.

We have hitherto handled the particulars which yield best, and easiest, and plentifullest nourishment; and now we will speak of the best means of conveying and converting the nourishment.

55. The first means is to procure that the nourishment may not be robbed and drawn away; wherein that which we have already said is very material; to provide that the reins draw not too strongly an over great part of the blood into urine. To this add that precept of Aristotle, that wine be forborn in all consumptions; for that the spirits of the wine do prey upon the roscid juice of the body, and inter-common with the spirits of the body, and so deceive and rob them of their nourishment. And therefore if the consumption, growing from the weakness of the stomach, do force you to use wine, let it always be burnt, that the quicker spirits may evaporate; or, at the least, quenched with two little wedges of gold, six or seven times repeated. Add also to this provision, that there be not too much expence of the nourishment, by ex-

haling and sweating; and therefore if the patient be apt to sweat, it must be gently restrained. But chiefly Hippocrates's rule is to be followed, who adviseth quite contrary to that which is in use: namely, that the linen or garment next the flesh be, in winter, dry and oft changed; and in summer seldom changed, and smeared over with oil; for certain it is, that any substance that is fat, doth a little fill the pores of the body, and stay sweat in some degree: but the more cleanly way is, to have the linen smeared lightly over with oil of sweet almonds; and not to forbear shifting as oft as is fit.

56. The second means is, to send forth the nourishment into the parts more strongly; for which the working must be by strengthening of the stomach; and in this, because the stomach is chiefly comforted by wine and hot things, which otherwise hurt; it is good to resort to outward applications to the stomach: Wherein it hath been tried, that the quilts of roses, spices, mastic, wormwood, mint, *etc.* are nothing so helpful, as to take a cake of new bread, and to bedew it with a little sack, or Alicant; and to dry it; and after it be dried a little before the fire, to put it within a clean napkin, and to lay it to the stomach; for it is certain, that all flour hath a potent virtue of astriction; in so much as it hardeneth a piece of flesh, or a flower, that is laid in it: and therefore a bag quilted with bran is likewise very good; but it drieth somewhat too much, and therefore it must not lie long.

57. The third means, which may be a branch of the former, is to send forth the nourishment the better by sleep. For we see, that bears, and other creatures that sleep in the winter, wax exceeding fat: and certain it is, as it is commonly believed, that sleep doth nourish much; both for that the spirits do less spend the nourishment in sleep, than when living creatures are awake; and because, that which is to the present purpose, it helpeth to thrust out the nourishment into the parts. Therefore in aged men, and weak bodies, and such as abound not with choler, a short

sleep after dinner doth help to nourish; for in such bodies there is no fear of an over-hasty digestion, which is the inconvenience of postmeridian sleeps. Sleep also in the morning, after the taking of somewhat of easy digestion, as milk from the cow, nourishing broth, or the like, doth further nourishment; but this should be done sitting upright, that the milk or broth may pass the more speedily to the bottom of the stomach.

58. The fourth means is, to provide that the parts themselves may draw to them the nourishment strongly. There is an excellent observation of Aristotle; that a great reason, why plants, some of them, are of greater age than living creatures, is, for that they yearly put forth new leaves and boughs: whereas living creatures put forth, after their period of growth, nothing that is young, but hair and nails, which are excrements, and no parts. And it is most certain, that whatsoever is young, doth draw nourishment better than that which is old; and then, that which is the mystery of that observation, young boughs, and leaves, calling the sap up to them, the same nourisheth the body in the passage. And this we see notably proved also, in that the oft cutting, or polling of hedges, trees, and herbs, doth conduce much to their lasting. Transfer therefore this observation to the helping of nourishment in living creatures: the noblest and principal use whereof is, for the prolongation of life; restoration of some degree of youth; and intineration of the parts: for certain it is, that there are in living creatures parts that nourish and repair easily, and parts that nourish and repair hardly: and you must refresh and renew those that are easy to nourish, that the other may be refreshed, and, as it were, drink in nourishment in the passage. Now we see that draught oxen, put into good pasture, recover the flesh of young beef; and men after long emaciating diets wax plump and fat, and almost new: so that you may surely conclude, that the frequent and wise use of those emaciating diets, and of purgings, and perhaps of some kind of bleeding, is a prin-

cipal means of prolongation of life, and restoring some degree of youth: for as we have often said, death cometh upon living creatures like the torment of Mezentius:

Mortua quin etiam jungebat corpora vivis,
Componens manibusque manus, atque oribus ora.
Æn. viii. 485.

For the parts in man's body easily reparable, as spirits, blood and flesh, die in the embracement of the parts hardly reparable, as bones, nerves, and membranes; and likewise some entrails, which they reckon amongst the spermatical parts, are hard to repair, though that division of spermatical and menstrual parts be but a conceit. And this same observation also may be drawn to the present purpose of nourishing emaciated bodies: and therefore gentle frication draweth forth the nourishment, by making the parts a little hungry, and heating them; whereby they call forth nourishment the better. This frication I wish to be done in the morning. It is also best done by the hand, or a piece of scarlet wool, wet a little with oil of almonds, mingled with a small quantity of bay-salt, or saffron, we see that the very currying of horses doth make them fat, and in good liking.

59. The fifth means is, to further the very act of assimilation of nourishment; which is done by some outward emollients, that make the parts more apt to assimilate. For which I have compounded an ointment of excellent odour, which I call Roman ointment; *vide* the receipt. The use of it would be between sleeps; for in the latter sleep the parts assimilate chiefly.

Experiment solitary touching Filum medicinale.

60. There be many medicines, which by themselves would do no cure, but perhaps hurt; but being applied in a certain order, one after another, do great cures. I have tried, myself, a remedy for the gout, which hath seldom failed, but driven it away in twenty-four hours space: it is first to apply a poultis, of which *vide* the receipt, and then a bath, or fomentation, of

which *vide* the receipt; and then a plaister, *vide* the receipt. The poultis relaxeth the pores, and maketh the humour apt to exhale. The fomentation calleth forth the humour by vapours; but yet in regard of the way made by the poultis, draweth gently; and therefore draweth the humour out, and doth not draw more to it; for it is a gentle fomentation, and hath withal a mixture, though very little, of some stupefactive. The plaister is a moderate astringent plaister, which repelleth new humours from falling. The poultis alone would make the part more soft and weak, and apter to take the defluxion and impression of the humour. The fomentation alone, if it were too weak, without way made by the poultis, would draw forth little; if too strong, it would draw to the part, as well as draw from it. The plaister alone would pen the humour already contained in the part, and so exasperate it, as well as forbid new humour. Therefore they must be all taken in order, as is said. The poultis is to be laid to for two or three hours: the fomentation for a quarter of an hour, or somewhat better, being used hot, and seven or eight times repeated: the plaister to continue on still, till the part be well confirmed.

Experiment solitary touching cure by custom.

61. There is a secret way of cure, unpractised, by assuetude of that which in itself hurteth. Poisons have been made, by some, familiar, as hath been said. Ordinary keepers of the sick of the plague are seldom infected. Enduring of tortures, by custom, hath been made more easy; the brooking of enormous quantity of meats, and so of wine or strong drink, hath been, by custom, made to be without surfeit or drunkennesss. And generally diseases that are chronical, as coughs, phthisics, some kinds of palsies, lunacies, *etc.* are most dangerous at the first: therefore a wise physician will consider whether a disease be incruable; or whether the just cure of it be not full of peril; and if he find it to be such, let him resort to palliation; and alleviate the symptom, without busying

himself too much with the perfect cure: and many times, if the patient be indeed patient, that course will exceed all expectation. Likewise the patient himself may strive, by little and little, to overcome the symptom in the exacerbation, and so by time, turn suffering into nature.

Experiment solitary touching cure by excess.

62. Divers diseases, especially chronical, such as quartan agues, are sometimes cured by surfeit and excesses: as excess of meat, excess of drink, extraordinary fasting, extraordinary stirring or lassitude, and the like. The cause is, for that diseases of continuance get an adventitious strength from custom, besides their material cause from the humours: so that the breaking of the custom doth leave them only to their first cause; which if it be any thing weak will fall off. Besides, such excesses do excite and spur nature, which thereupon rises more forcibly against the disease.

Experiment solitary touching cure by motion of consent.

63. There is in the body of man a great consent in the motion of the several parts. We see, it is childrens sport, to prove whether they can rub upon their breast with one hand, and pat upon their forehead with another; and straightways they shall sometimes rub with both hands, or pat with both hands. We see, that when the spirits that come to the nostrils expel a bad scent, the stomach is ready to expel by vomit. We find that in consumptions of the lungs, when nature cannot expel by cough, men fall into fluxes of the belly, and then they die. So in pestilent diseases, if they cannot be expelled by sweat, they fall likewise into looseness; and that is commonly mortal. Therefore physicians should ingeniously contrive, how by emotions that are in their power, they may excite inward motions that are not in their power, by consent: as by the stench of feathers, or the like, they cure the rising of the mother.

Experiment solitary touching cure of diseases which are contrary to predisposition.

64. HIPPOCRATES' aphorism, in *morbis minus*, is a good profound aphorism. It importeth, that diseases, contrary to the complexion, age, sex, season of the year, diet, *etc.* are more dangerous than those that are concurrent. A man would think it should be otherwise; for that, when the accident of sickness, and the natural disposition, do second the one the other, the disease should be more forcible: and so, no doubt, it is, if you suppose like quantity of matter. But that which maketh good the aphorism is, because such diseases do shew a greater collection of matter, by that they are able to overcome those natural inclinations to the contrary. And therefore in diseases of that kind, let the physician apply himself more to purgation than to alteration; because the offence is in the quantity; and the qualities are rectified of themselves.

Experiment solitary, touching preparations before purging, and settling of the body afterwards.

65. PHYSICIANS do wisely prescribe, that there be preparatives used before just purgations; for certain it is, that purgers do many times great hurt, if the body be not accommodated, both before and after the purging. The hurt that they do, for want of preparation before purging, is by the sticking of the humours, and their not coming fair away; which causeth in the body great perturbations and ill accidents during the purging; and also the diminishing and dulling of the working of the medicine itself, that it purgeth not sufficiently: therefore the work of preparation is double; to make the humours fluid and mature, and to make the passages more open: for both those help to make the humours pass readily. And for the former of these, syrups are most profitable; and for the latter, apozemes, or preparing broths; clysters also help, lest the medicine stop in the guts, and work gripingly. But it is true, that

bodies abounding with humours, and fat bodies, and open weather, are preparatives in themselves; because they make the humours more fluid. But let a physician beware, how he purge after hard frosty weather, and in a lean body, without preparation. For the hurt that they may do after purging, it is caused by the lodging of some humours in ill places: for it is certain, that there be humours, which somewhere placed in the body, are quiet, and do little hurt; in other places, especially passages, do much mischief. Therefore it is good, after purging, to use apozemes and broths, not so much opening as those used before purging; but abstersive and mundifying clysters also are good to conclude with, to draw away the reliques of the humours, that may have descended to the lower region of the body.

Experiment solitary touching stanching of blood.

66. Blood is stanched divers ways. First, by astringents, and repercussive medicines. Secondly, by drawing of the spirits and blood inwards; which is done by cold; as iron or a stone laid to the neck doth stanch the bleeding at the nose; also it hath been tried, that the testicles being put into sharp vinegar, hath made a sudden recess of the spirits, and stanched blood. Thirdly, by the recess of the blood by sympathy. So it hath been tried, that the part that bleedeth, being thrust into the body of a capon or sheep, new ript and bleeding, hath stanched blood; the blood, as it seemeth, sucking and drawing up, by similitude of substance, the blood it meeteth with, and so itself going back. Fourthly, by custom and time; so the Prince of Orange, in his first hurt by the Spanish boy, could find no means to stanch the blood, either by medicine or ligament; but was fain to have the orifice of the wound stopped by men's thumbs, succeeding one another, for the space at the least of two days; and at the last the blood by custom only retired. There is a fifth way also in use, to let blood in an adverse part, for a revulsion.

Experiment solitary touching change of aliments and medicines.

67. It helpeth, both in medicine and aliment, to change and not to continue the same medicine and aliment still. The cause is, for that nature, by continual use of any thing, groweth to a satiety and dulness, either of appetite or working. And we see that assuetude of things hurtful doth make them lose their force to hurt; as poison, which with use some have brought themselves to brook. And therefore it is no marvel, though things helpful by custom lose their force to help: I count intermission almost the same thing with change; for that that hath been intermitted, is after a sort new.

Experiment solitary touching diets.

68. It is found by experience, that in diets of guaiacum, sarza, and the like, especially if they be strict, the patient is more troubled in the beginning than after continuance; which hath made some of the more delicate sort of patients give them over in the midst; supposing that if those diets trouble them so much at first, they shall not be able to endure them to the end. But the cause is, for that all those diets do dry up humours, rheums, and the like; and they cannot dry up until they have first attenuated; and while the humour is attenuated, it is more fluid than it was before, and troubleth the body a great deal more, until it be dried up and consumed. And therefore patients must expect a due time, and not keck at them at the first.

Experiments in consort, touching the production of cold.

The producing of cold is a thing very worthy the inquisition; both for use and disclosure of causes. For heat and cold are nature's two hands, whereby she chiefly worketh; and heat we have in readiness, in respect of the fire; but for cold we must stay till it cometh, or seek it in deep caves, or high mountains: and when all is done, we cannot obtain it in

any great degree: for furnaces of fire are far hotter than a summer's sun; but vaults or hills are not much colder than a winter's frost.

69. The first means of producing cold, is that which nature presenteth us withal; namely, the expiring of cold out of the inward parts of the earth in winter, when the sun hath no power to overcome it; the earth being, as hath been noted by some, *primum frigidum.* This hath been asserted, as well by ancient as by modern philosophers: it was the tenet of Parmenides. It was the opinion of the author of the discourse in Plutarch, for I take it that book was not Plutarch's own, *De primo frigido.* It was the opinion of Telesius, who hath renewed the philosophy of Parmenides, and is the best of the novelists.

70. The second cause of cold is the contact of cold bodies; for cold is active and transitive into bodies adjacent, as well as heat: which is seen in those things that are touched with snow or cold water. And therefore, whosoever will be an inquirer into nature, let him resort to a conservatory of snow and ice; such as they use for delicacy to cool wine in summer: which is a poor and contemptible use, in respect of other uses, that may be made of such conservatories.

71. The third cause is the primary nature of all tangible bodies: for it is well to be noted, that all things, whatsoever, tangible, are of themselves cold; except they have an accessory heat by fire, life, or motion: for even the spirit of wine, or chemical oils, which are so hot in operation, are to the first touch cold; and air itself compressed, and condensed a little by blowing, is cold.

72. The fourth cause is the density of the body; for all dense bodies are colder than most other bodies; as metals, stone, glass; and they are longer in heating than softer bodies. And it is certain, that earth, dense, tangible, hold all of the nature of cold. The cause is, for that all matters tangible being cold, it must needs follow, that where the matter is most congregate, the cold is the greater.

73. The fifth cause of cold, or rather of increase

and vehemency of cold, is a quick spirit inclosed in a cold body: as will appear to any that shall attentively consider of nature in many instances. We see nitre, which hath a quick spirit, is cold; more cold to the tongue than a stone; so water is colder than oil, because it hath a quicker spirit; for all oil, though it hath the tangible parts better digested than water, yet hath it a duller spirit: so snow is colder than water, because it hath more spirit within it: so we see that salt put to ice, as in the producing of the artificial ice, increaseth the activity of cold: so some *insecta* which have spirit of life, as snakes and silkworms, are to the touch cold: so quicksilver is the coldest of metals, because it is fullest of spirit.

74. The sixth cause of cold is the chasing and driving away of spirits, such as have some degree of heat: for the banishing of the heat must needs leave any body cold. This we see in the operation of opium and stupefactives upon the spirits of living creatures: and it were not amiss to try opium, by laying it upon the top of a weather-glass, to see whether it will contract the air: but I doubt it will not succeed; for besides that the virtue of opium will hardly penetrate through such a body as glass, I conceive that opium, and the like, make the spirits fly rather by malignity, than by cold.

75. Seventhly, the same effect must follow upon the exhaling or drawing out of the warm spirits, that doth upon the flight of the spirits. There is an opinion, that the moon is magnetical of heat, as the sun is of cold and moisture: it were not amiss therefore to try it, with warm waters; the one exposed to the beams of the moon, the other with some skreen betwixt the beams of the moon and the water, as we use to the sun for shade; and to see whether the former will cool sooner. And it were also good to inquire, what other means there may be to draw forth the exile heat which is in the air; for that may be a secret of great power to produce cold weather.

Experiments in consort, touching the version and transmutation of air into water.

We have formerly set down the means of turning air into water, in the experiment 27. But because it is *magnale naturæ*, and tendeth to the subduing of a very great effect, and is also of manifold use, we will add some instances in consort that give light thereunto.

76. It is reported by some of the ancients, that sailors have used, every night, to hang fleeces of wool on the sides of their ships, the wool towards the water; and that they have crushed fresh water out of them, in the morning, for their use. And thus much we have tried, that a quantity of wool tied loose together, being let down into a deep well, and hanging in the middle, some three fathom from the water, for a night, in the winter time; increased in weight, as I now remember, to a fifth part.

77. It is reported by one of the ancients, that in Lydia, near Pergamus, there were certain workmen in time of wars fled into caves; and the mouth of the caves being stopped by the enemies, they were famished. But long time after the dead bones were found; and some vessels which they had carried with them; and the vessels full of water; and that water thicker, and more towards ice, than common water: which is a notable instance of condensation and induration by burial under earth, in caves, for long time; and of version also as it should seem of air into water; if any of those vessels were empty. Try therefore a small bladder hung in snow, and the like in nitre, and the like in quicksilver: and if you find the bladders fallen or shrunk, you may be sure the air is condensed by the cold of those bodies, as it would be in a cave under earth.

78. It is reported of very good credit, that in the East Indies, if you set a tub of water open in a room where cloves are kept, it will be drawn dry in twenty-four hours; though it stand at some distance from the cloves. In the country, they use many times, in deceit, when their wool is new shorn, to set some pails

of water by in the same room, to increase the weight of the wool. But it may be, that the heat of the wool, remaining from the body of the sheep, or the heat gathered by the lying close of the wool, helpeth to draw the watery vapour; but that is nothing to the version.

79. It is reported also credibly, that wool new shorn, being laid casually upon a vessel of verjuice, after some time, had drunk up a great part of the verjuice, though the vessel were whole without any flaw, and had not the bung-hole open. In this instance, there is, upon the by, to be noted, the percolation or suing of the verjuice through the wood; for verjuice of itself would never have passed through the wood: so as, it seemeth, it must be first in a kind of vapour, before it pass.

80. It is especially to be noted, that the cause that doth facilitate the version of air into water, when the air is not in gross, but subtilly mingled with tangible bodies, is, as hath been partly touched before, for that tangible bodies have an antipathy with air; and if they find any liquid body that is more dense near them, they will draw it: and after they have drawn it, they will condense it more, and in effect incorporate it; for we see that a spunge, or wool, or sugar, or a woollen cloth, being put but in part in water or wine, will draw the liquor higher, and beyond the place where the water or wine cometh. We see also, that wood, lute strings, and the like, do swell in moist seasons; as appeareth by the breaking of the strings, the hard turning of the pegs, and the hard drawing forth of boxes, and opening of wainscot doors; which is a kind of infusion; and is much like to an infusion in water, which will make wood to swell; as we see in the filling of the chops of bowls, by laying them in water. But for that part of these experiments which concerneth attraction, we will reserve it to the proper title of attraction.

81. There is also a version of air into water seen in the sweating of marbles and other stones; and of wainscot before and in moist weather. This must

be, either by some moisture the body yieldeth, or else by the moist air thickened against the hard body. But it is plain, that it is the latter; for that we see wood painted with oil colour, will sooner gather drops in a moist night, than wood alone; which is caused by the smoothness and closeness; which letteth in no part of the vapour, and so turneth it back, and thickeneth it into dew. We see also, that breathing upon a glass, or smooth body, giveth a dew; and in frosty mornings, such as we call rime frosts, you shall find drops of dew upon the inside of glass windows; and the frost itself upon the ground is but a version or condensation of the moist vapours of the night, into a watery substance: dews likewise, and rain, are but the returns of moist vapours condensed; the dew, by the cold only of the sun's departure, which is the gentler cold; rains, by the cold of that which they call the middle region of the air; which is the more violent cold.

82. It is very probable, as hath been touched, that that which will turn water into ice, will likewise turn air some degree nearer unto water. Therefore try the experiment of the artificial turning water into ice, whereof we shall speak in another place, with air in place of water, and the ice about it. And although it be a greater alteration to turn air into water, than water into ice; yet there is this hope, that by continuing the air longer time, the effect will follow: for that artificial conversion of water into ice, is the work of a few hours; and this of air may be tried by a month's space, or the like.

Experiments in consort touching induration of bodies.

Induration, or lapidification of substances more soft, is likewise another degree of condensation; and is a great alteration in nature. The effecting and accelerating thereof is very worthy to be inquired. It is effected by three means. The first is by cold; whose property is to condense and constipate, as hath been said. The second is by heat; which is not proper but by consequence; for the

heat doth attenuate; and by attenuation doth send forth the spirit and moister part of a body; and upon that, the more gross of the tangible parts do contract and serre themselves together; both to avoid *vacuum*, as they call it, and also to munite themselves against the force of the fire, which they have suffered. And the third is by assimulation; when a hard body assimulateth a soft, being contiguous to it.

The examples of induration, taking them promiscuously, are many: as the generation of stones within the earth, which at the first are but rude earth or clay: and so of minerals, which come, no doubt, at first of juices concrete, which afterwards indurate: and so of porcellane, which is an artificial cement, buried in the earth a long time; and so the making of brick and tile: also the making of glass of a certain sand and brake-roots, and some other matters; also the exudations of rock-diamonds and crystal, which harden with time; also the induration of bead-amber, which at first is a soft substance; as appeareth by the flies and spiders which are found in it; and many more: but we will speak of them distinctly.

83. For indurations by cold, there be few trials of it; for we have no strong or intense cold here on the surface of the earth, so near the beams of the sun, and the heavens. The likeliest trial is by snow and ice; for as snow and ice, especially being holpen and their cold activated by nitre or salt, will turn water into ice, and that in a few hours; so it may be, it will turn wood or stiff clay into stone, in longer time. Put therefore into a conserving pit of snow and ice, adding some quantity of salt and nitre, a piece of wood, or a piece of tough clay, and let it lie a month or more.

84. Another trial is by metalline waters, which have virtual cold in them. Put therefore wood or clay into smiths water, or other metalline water, and try whether it will not harden in some reasonable time. But I understand it of metalline waters that come by washing or quenching; and not of strong waters that come by dissolution; for they are too corrosive to consolidate.

85. It is already found that there are some natural spring waters, that will inlapidate wood; so that you shall see one piece of wood, whereof the part above the water shall continue wood; and the part under the water shall be turned into a kind of gravelly stone. It is likely those waters are of some metalline mixture; but there would be more particular inquiry made of them. It is certain, that an egg was found, having laid many years in the bottom of a mote, where the earth had somewhat overgrown it; and this egg was come to the hardness of a stone, and had the colours of the white and yolk perfect, and the shell shining in small grains like sugar or alabaster.

86. Another experience there is of induration by cold, which is already found; which is, that metals themselves are hardened by often heating and quenching in cold water: for cold ever worketh most potently upon heat precedent.

87. For induration by heat, it must be considered, that heat, by the exhaling of the moister parts, doth either harden the body, as in bricks, tiles, *etc.* or if the heat be more fierce, maketh the grosser part itself run and melt; as in the making of ordinary glass; and in the vitrification of earth, as we see in the inner parts of furnaces, and in the vitrification of brick, and of metals. And in the former of these, which is the hardening by baking without melting, the heat hath these degrees; first, it indurateth, and then maketh fragile; and lastly it doth incinerate and calcinate.

88. But if you desire to make an induration with toughness, and less fragility, a middle way should be taken; which is that which Aristotle hath well noted; but should be thoroughly verified. It is to decoct bodies in water for two or three days; but they must be such bodies into which the water will not enter; as stone and metal: for if they be bodies into which the water will enter, then long seething will rather soften than indurate them; as hath been tried in eggs, *etc.* therefore softer bodies must be put into bottles, and the bottles hung into water seething,

with the mouths open above the water, that no water may get in; for by this means the virtual heat of the water will enter; and such a heat, as will not make the body adust or fragile; but the substance of the water will be shut out. This experiment we made; and it sorted thus. It was tried with a piece of free-stone, and with pewter, put into the water at large. The free-stone we found received in some water; for it was softer and easier to scrape than a piece of the same stone kept dry. But the pewter, into which no water could enter, became more white and liker to silver, and less flexible by much. There were also put into an earthen bottle, placed as before, a good pellet of clay, a piece of cheese, a piece of chalk, and a piece of free-stone. The clay came forth almost of the hardness of stone; the cheese likewise very hard, and not well to be cut; the chalk and free-stone much harder than they were. The colour of the clay inclined not a whit to the colour of brick, but rather to white, as in ordinary drying by the sun. Note, that all the former trials were made by a boiling upon a good hot fire, renewing the water as it consumed, with other hot water; but the boiling was but for twelve hours only; and it is like that the experiment would have been more effectual, if the boiling had been for two or three days, as we prescribed before.

89. As touching assimilation, for there is a degree of assimilation even in inanimate bodies, we see examples of it in some stones in clay-grounds, lying near to the top of the earth, where pebble is; in which you may manifestly see divers pebbles gathered together, and a crust of cement or stone between them, as hard as the pebbles themselves: and it were good to make a trial of purpose, by taking clay, and putting in it divers pebble stones, thick set, to see whether in continuance of time, it will not be harder than other clay of the same lump, in which no pebbles are set. We see also in ruins of old walls, especially towards the bottom, the mortar will become as hard as the brick: we see also, that the wood on the sides

of vessels of wine, gathereth a crust of tartar, harder than the wood itself; and scales likewise grow to the teeth harder than the teeth themselves.

90. Most of all, induration by assimilation appeareth in the bodies of trees and living creatures: for no nourishment that the tree receiveth, or that the living creature receiveth, is so hard as wood, bone, or horn, *etc.* but is indurated after by assimilation.

Experiment solitary touching the version of water into air.

91. The eye of the understanding is like the eye of the sense: for as you may see great objects through small crannies or levels; so you may see great axioms of nature through small and contemptible instances. The speedy depredation of air upon watry moisture, and version of the same into air, appeareth in nothing more visible, than in the sudden discharge or vanishing of a little cloud of breath or vapour from glass, or the blade of a sword, or any such polished body, such as doth not at all detain or imbibe the moisture; for the mistiness scattereth and breaketh up suddenly. But the like cloud, if it were oily or fatty, will not discharge; not because it sticketh faster; but because air preyeth upon water; and flame and fire upon oil; and therefore to take out a spot of grease they use a coal upon brown paper; because fire worketh upon grease or oil, as air doth upon water. And we see paper oiled, or wood oiled, or the like, last long moist; but wet with water, dry or putrify sooner. The cause is, for that air meddleth little with the moisture of oil.

Experiment solitary touching the force of union.

92. There is an admirable demonstration in the same trifling instance of the little cloud upon glass, or gems, or blades of swords, of the force of union, even in the least quantities and weakest bodies, how much it conduceth to preservation of the present form, and the resisting of a new. For mark well the discharge of that cloud; and you shall see it

ever break up, first in the skirts and last in the midst. We see likewise, that much water draweth forth the juice of the body infused; but little water is imbibed by the body: and this is a principal cause, why in operation upon bodies for their version or alteration, the trial in great quantities doth not answer the trial in small; and so deceiveth many; for that, I say, the greater body resisteth more any alteration of form, and requireth far greater strength in the active body that should subdue it.

Experiment solitary touching the producing of feathers and hairs of divers colours.

93. We have spoken before, in the fifth instance, of the cause of orient colours in birds; which is by the fineness of the strainer; we will now endeavour to reduce the same axiom to a work. For this writing of our *Sylva Sylvarum* is, to speak properly, not natural history, but a high kind of natural magic. For it is not a description only of nature, but a breaking of nature into great and strange works. Try therefore the anointing over of pigeons, or other birds, when they are but in their down; or of whelps, cutting their hair as short as may be; or of some other beast; with some ointment that is not hurtful to the flesh, and that will harden and stick very close; and see whether it will not alter the colours of the feathers or hair. It is received, that the pulling off the first feathers of birds clean, will make the new come forth white: and it is certain that white is a penurious colour, and where moisture is scant. So blue violets, and other flowers, if they be starved, turn pale and white; birds and horses, by age or scars, turn white: and the hoar hairs of men come by the same reason. And therefore in birds, it is very likely, that the feathers that come first will be many times of divers colours, according to the nature of the bird, for that the skin is more porous; but when the skin is more shut and close, the feathers will come white. This is a good experiment, not only for the producing of birds and beasts of strange

colours; but also for the disclosure of the nature of colours themselves; which of them require a finer porosity, and which a grosser.

Experiment solitary touching the nourishment of living creatures before they be brought forth.

94. It is a work of providence, that hath been truly observed by some, that the yolk of the egg conduceth little to the generation of the bird, but only to the nourishment of the same: for if a chicken be opened, when it is new hatched, you shall find much of the yolk remaining. And it is needful, that birds that are shaped without the female's womb have in the egg, as well matter of nourishment, as matter of generation for the body. For after the egg is laid, and severed from the body of the hen, it hath no more nourishment from the hen, but only a quickning heat when she sitteth. But beasts and men need not the matter of nourishment within themselves, because they are shaped within the womb of the female, and are nourished continually from her body.

Experiments in consort touching sympathy and antipathy for medicinal use.

95. It is an inveterate and received opinion, that cantharides applied to any part of the body, touch the bladder and exulcerate it, if they stay on long. It is likewise received, that a kind of stone, which they bring out of the West-Indies, hath a peculiar force to move gravel, and to dissolve the stone; insomuch, as laid but to the wrist, it hath so forcibly sent down gravel, as men have been glad to remove it, it was so violent.

96. It is received, and confirmed by daily experience, that the soles of the feet have great affinity with the head and the mouth of the stomach: as we see, going wet-shod, to those that use it not, affecteth both: applications of hot powders to the feet attenuate first, and after dry the rheum: and therefore a physician that would be mystical, prescribeth for the cure of the rheum, that a man should walk continu-

ally upon a camomile-alley; meaning, that he should put camomile within his socks. Likewise pigeons bleeding, applied to the soles of the feet, ease the head: and soporiferous medicines applied unto them, provoke sleep.

97. It seemeth, that as the feet have a sympathy with the head, so the wrists and hands have a sympathy with the heart; we see the affections and passions of the heart and spirits are notably disclosed by the pulse: and it is often tried, that juices of stock-gilly-flowers, rose-campian, garlick, and other things, applied to the wrists, and renewed, have cured long agues. And I conceive, that washing with certain liquors the palms of the hands doth much good: and they do well in heats of agues, to hold in the hands eggs of alabaster and balls of crystal.

Of these things we shall speak more, when we handle the title of sympathy and antipathy in the proper place.

Experiment solitary touching the secret processes of nature.

98. The knowledge of man hitherto hath been determined by the view or sight; so that whatsoever is invisible, either in respect of the fineness of the body itself, or the smallness of the parts, or of the subtilty of the motion, is little inquired. And yet these be the things that govern nature principally; and without which you cannot make any true analysis and indication of the proceedings of nature. The spirits or pneumaticals, that are in all tangible bodies, are scarce known. Sometimes they take them for *vacuum*; whereas they are the most active of bodies. Sometimes they take them for air; from which they differ exceedingly, as much as wine from water; and as wood from earth. Sometimes they will have them to be natural heat, or a portion of the element of fire; whereas some of them are crude and cold. And sometimes they will have them to be the virtues and qualities of the tangible parts which

they see; whereas they are things by themselves. And then when they come to plants and living creatures, they call them souls. And such superficial speculations they have; like prospectives, that shew things inward when they are but paintings. Neither is this a question of words, but infinitely material in nature. For spirits are nothing else but a natural body, rarified to a proportion, and included in the tangible parts of bodies, as in an integument. And they be no less differing one from the other, than the dense or tangible parts; and they are in all tangible bodies whatsoever more or less; and they are never almost at rest: and from them and their motions, principally proceed arefaction, colliquation, concoction, maturation, putrefaction, vivification, and most of the effects of nature: for, as we have figured them in our *Sapientia veterum*, in the fable of Proserpina, you shall in the infernal regiment hear little doings of Pluto, but most of Proserpina: for tangible parts in bodies are stupid things; and the spirits do in effect all. As for the differences of tangible parts in bodies, the industry of the chemists hath given some light, in discerning by their separations the oily, crude, pure, impure, fine, gross parts of bodies, and the like. And the physicians are content to acknowledge, that herbs and drugs have divers parts; as that opium hath a stupefactive part and a heating part; the one moving sleep, the other a sweat following; and that rhubarb hath purging parts and astringent parts, *etc.* But this whole inquisition is weakly and negligently handled. And for the more subtle differences of the minute parts, and the posture of them in the body, which also hath great effects, they are not at all touched: as for the motions of the minute parts of bodies, which do so great effects, they have not been observed at all; because they are invisible, and occur not to the eye; but yet they are to be deprehended by experience: as Democritus said well, when they charged him to hold, that the world was made of such little motes, as were seen in the sun; *Atomus*, saith he, *necessitate rationis et ex-*

perientiæ esse convincitur; atomum enim nemo unquam vidit. And therefore the tumult in the parts of solid bodies, when they are compressed, which is the cause of all flight of bodies through the air, and of other mechanical motions, as hath been partly touched before, and shall be thoroughly handled in due place, is not seen at all. But nevertheless, if you know it not, or inquire it not attentively and diligently, you shall never be able to discern, and much less to produce a number of mechanical motions. Again, as to the motions corporal, within the inclosures of bodies, whereby the effects, which were mentioned before, pass between the spirits and the tangible parts, which are arefaction, colliquation, concoction, maturation, *etc.* they are not at all handled. But they are put off by the names of virtues, and natures, and actions, and passions, and such other logical words.

Experiment solitary touching the power of heat.

99. It is certain, that of all powers in nature heat is the chief; both in the frame of nature, and in the works of art. Certain it is likewise, that the effects of heat are most advanced, when it worketh upon a body without loss or dissipation of the matter; for that ever betrayeth the account. And therefore it is true, that the power of heat is best perceived in distillations which are performed in close vessels and receptacles. But yet there is a higher degree; for howsoever distillations do keep the body in cells and cloisters, without going abroad, yet they give space unto bodies to turn into vapour: to return into liquor; and to separate one part from another. So as nature doth expatiate, although it hath not full liberty: whereby the true and ultime operations of heat are not attained. But if bodies may be altered by heat, and yet no such reciprocation of rarefaction, and of condesation, and of separation, admitted; then it is like that this Proteus of matter, being held by the sleeves, will turn and change into many metamorphoses. Take therefore a square vessel of iron, in form of a cube, and let it have good thick and strong sides.

Put into it a cube of wood, that may fill it as close as may be; and let it have a cover of iron, as strong at least as the sides; and let it be well luted, after the manner of the chemists. Then place the vessel within burning coals, kept quick kindled for some few hours space. Then take the vessel from the fire, and take off the cover, and see what is become of the wood. I conceive, that since all inflammation and evaporation are utterly prohibited, and the body still turned upon itself, that one of these two effects will follow: either that the body of the wood will be turned into a kind of *amalgama*, as the chemists call it, or that the finer part will be turned into air, and the grosser stick as it were baked, and incrustate upon the sides of the vessel, being become of a denser matter than the wood itself crude. And for another trial, take also water, and put it in the like vessel, stopped as before; but use a gentler heat, and remove the vessel sometimes from the fire; and again, after some small time, when it is cold, renew the heating of it; and repeat this alteration some few times: and if you can once bring to pass, that the water, which is one of the simplest of bodies, be changed in colour, odour, or taste, after the manner of compound bodies, you may be sure that there is a great work wrought in nature, and a notable entrance made into strange changes of bodies and productions; and also a way made to do that by fire, in small time, which the sun and age do in long time. But of the admirable effects of this distillation in close, for so we will call it, which is like the wombs and matrices of living creatures, where nothing expireth nor separateth, we will speak fully, in the due place; not that we aim at the making of Paracelus' pygmies, or any such prodigious follies; but that we know the effects of heat will be such, as will scarce fall under the conceit of man, if the force of it be altogether kept in.

Experiment solitary touching the impossibility of annihilation.

100. THERE is nothing more certain in nature than that it is impossible for any body to be utterly annihilated; but that, as it was the work of the omnipotency of God to make somewhat of nothing, so it requireth the like omnipotency to turn somewhat into nothing. And therefore it is well said by an obscure writer of the sect of the chemists; that there is no such way to effect the strange transmutations of bodies as to endeavour and urge by all means the reducing of them to nothing. And herein is contained also a great secret of preservation of bodies from change; for if you can prohibit, that they neither turn into air because no air cometh to them; nor go into the bodies adjacent, because they are utterly heterogeneal; nor make a round and circulation within themselves; they will never change, though they be in their nature never so perishable or mutable. We see how flies, and spiders, and the like, get a sepulchre in amber, more durable than the monument and embalming of the body of any king. And I conceive the like will be of bodies put into quicksilver. But then they must be but thin, as a leaf, or a piece of paper or parchment; for if they have a greater crassitude, they will alter in their own body, though they spend not. But of this we shall speak more when we handle the title of conservation of bodies.

NATURAL HISTORY.

CENTURY II.

Experiments in consort touching Music.

MUSIC, in the practice, hath been well pursued, and in good variety; but in the theory, and especially in the yielding of the causes of the practice, very weakly; being reduced into certain mystical subtilties of no use and not much truth. We shall, therefore, after our manner, join the contemplative and active part together.

101. ALL sounds are either musical sounds, which we call tones; whereunto there may be an harmony; which sounds are ever equal; as singing, the sounds of stringed and wind instruments, the ringing of bells, *etc.* or immusical sounds, which are ever unequal; such as are the voice in speaking, all whisperings, all voices of beasts and birds, except they be singing birds, all percussions of stones, wood, parchment, skins, as in drums, and infinite others.

102. THE sounds that produce tones, are ever from such bodies as are in their parts and pores equal; as well as the sounds themselves are equal; and such are the percussions of metal, as in bells; of glass, as in the fillipping of a drinking glass; of air, as in mens voices whilst they sing, in pipes, whistles, organs, stringed instruments, *etc.* and of water, as in the nightingale pipes of regals, or organs, and other hydraulics; which the ancients had, and Nero did so much esteem, but are now lost. And if any man think, that the string of the bow and the string of the viol are neither of them equal bodies, and yet produce tones, he is in an error. For the sound is not created between the bow or *plectrum* and the string; but between the string and the air; no more than it is between the finger or quill, and the string in other instruments. So there

are, in effect, but three percussions that create tones; percussions of metals, comprehending glass and the like, percussions of air, and percussions of water.

103. The diapason or eight in music is the sweetest concord, in so much as it is in effect an unison; as we see in lutes that are strung in the base strings with two strings, one an eight above another; which make but as one sound. And every eighth note in ascent, as from eight to fifteen, from fifteen to twenty-two, and so *in infinitum*, are but scales of diapason. The cause is dark, and hath not been rendred by any; and therefore would be better contemplated. It seemeth that air, which is the subject of sounds, in sounds that are not tones, which are all unequal, as hath been said, admitteth much variety; as we see in the voices of living creatures; and likewise in the voices of several men, for we are capable to discern several men by their voices, and in the conjugation of letters, whence articulate sounds proceed; which of all others are most various. But in the sounds which we call tones, that are ever equal, the air is not able to cast itself into any such variety; but is forced to recur into one and the same posture or figure, only differing in greatness and smallness. So we see figures may be made of lines, crooked and straight, in infinite variety, where there is inequality; but circles, or squares, or triangles equilateral, which are all figures of equal lines, can differ but in greater or lesser.

104. It is to be noted, the rather lest any man should think, that there is any thing in this number of eight, to create the diapason, that this computation of eight is a thing rather received, than any true computation. For a true computation ought ever to be by distribution into equal portions. Now there be intervenient in the rise of eight, in tones, two beemolls, or half notes: so as if you divide the tones equally, the eight is but seven whole and equal notes; and if you subdivide that into half-notes, as it is in the stops of a lute, it maketh the number of thirteen.

105. Yet this is true; that in the ordinary rises and falls of the voice of man, not measuring the tone

by whole notes, and half-notes, which is the equal measure, there fall out to be two beemolls, as hath been said, between the unison and the diapason: and this varying is natural. For if a man would endeavour to raise or fall his voice, still by half-notes, like the stops of a lute; or by whole notes alone without halfs, as far as an eight; he will not be able to frame his voice unto it. Which sheweth, that after every three whole notes, nature requireth, for all harmonical use, one half-note to be interposed.

106. It is to be considered, that whatsoever virtue is in numbers, for conducing to concent of notes, is rather to be ascribed to the ante-number, than to the entire number; as namely, that the sound returneth after six or after twelve; so that the seventh or the thirteenth is not the matter, but the sixth or the twelfth; and the seventh and the thirteenth are but the limits and boundaries of the return.

107. The concords in music which are perfect or semiperfect, between the unison and the diapason, are the fifth, which is the most perfect; the third next; and the sixth, which is more harsh: and, as the ancients esteemed, and so do myself and some other yet, the fourth which they call diatessaron. As for the tenth, twelfth, thirteenth, and so *in infinitum*; they be but recurrences of the former, *viz.* of the third, the fifth, and the sixth; being an eight respectively from them.

108. For discords, the second and the seventh are of all others the most odious, in harmony, to the sense; whereof the one is next above the unison, the other next under the diapason: which may shew, that harmony requireth a competent distance of notes.

109. In harmony, if there be not a discord to the base, it doth not disturb the harmony, though there be a discord to the higher parts; so the discord be not of the two that are odious; and therefore the ordinary concent of four parts consisteth of an eight, a fifth, and a third to the base; but that fifth is a fourth to the treble, and the third is a sixth. And the cause is, for that the base striking more air, doth overcome and

drown the treble, unless the discord be very odious; and so hideth a small imperfection. For we see, that in one of the lower strings of a lute, there soundeth not the sound of the treble, nor any mixt sound, but only the sound of the base.

110. We have no music of quarter-notes; and it may be they are not capable of harmony; for we see the half-notes themselves do but interpose sometimes. Nevertheless we have some slides or relishes of the voice or strings, as it were continued without notes, from one tone to another, rising or falling, which are delightful.

111. The causes of that which is pleasing or ingrate to the hearing, may receive light by that which is pleasing or ingrate to the sight. There be two things pleasing to the sight, leaving pictures and shapes aside, which are but secondary objects; and please or displease but in memory; these two are colours and order. The pleasing of colour symbolizeth with the pleasing of any single tone to the ear; but the pleasing of order doth symbolize with harmony. And therefore we see in garden-knots, and the frets of houses, and all equal and well answering figures, as globes, pyramids, cones, cylinders, *etc.* how they please: whereas unequal figures are but deformities. And both these pleasures, that of the eye, and that of the ear, are but the effects of equality, good proportion, or correspondence: so that, out of question, equality and correspondence are the causes of harmony. But to find the proportion of that correspondence, is more abstruse; whereof notwithstanding we shall speak somewhat, when we handle tones in the general enquiry of sounds.

112. Tones are not so apt altogether to procure sleep, as some other sounds; as the wind, the purling of water, humming of bees, a sweet voice of one that readeth, *etc.* The cause whereof is, for that tones, because they are equal and slide not, do more strike and erect the sense than the other. And overmuch attention hindereth sleep.

113. There be in music, certain figures or tropes,

almost agreeing with the figures of rhetoric, and with the affections of the mind, and other senses. First, the division and quavering, which please so much in music, have an agreement with the glittering of light; as the moon-beams playing upon a wave. Again, the falling from a discord to a concord, which maketh great sweetness in music, hath an agreement with the affections, which are reintegrated to the better, after some dislikes: it agreeth, also with the taste, which is soon glutted with that which is sweet alone. The sliding from the close or cadence, hath an agreement with the figure in rhetoric, which they call *præter expectatum;* for there is a pleasure even in being deceived. The reports, and fuges, have an agreement with the figures in rhetoric, of repetition and traduction. The triplas, and changing of times, have an agreement with the changes of motions; as when galliard time, and measured time, are in the medley of one dance.

114. It hath been anciently held and observed, that the sense of hearing, and the kinds of music, have most operation upon manners; as, to encourage men, and make them warlike; to make them soft and effeminate; to make them grave; to make them light; to make them gentle and inclined to pity, *etc.* The cause is, for that the sense of hearing striketh the spirits more immediately, than the other senses; and more incorporeally than the smelling; for the sight, taste, and feeling, have their organs not of so present and immediate access to the spirits, as the hearing hath. And as for the smelling, which, indeed worketh also immediately upon the spirits, and is forcible while the object remaineth, it is with a communication of the breath or vapour of the object odorate; but harmony entering easily, and mingling not at all, and coming with a manifest motion, doth by custom of often affecting the spirits, and putting them into one kind of posture, alter not a little the nature of the spirits, even when the object is removed. And therefore we see, that tunes and airs, even in their own nature, have in themselves some affinity with

the affections; as there be merry tunes, doleful tunes, solemn tunes; tunes inclining mens minds to pity; warlike tunes, *etc.* So as it is no marvel if they alter the spirits, considering that tunes have a predisposition to the motion of the spirits in themselves. But yet it hath been noted, that though this variety of tunes doth dispose the spirits to variety of passions, conform unto them, yet generally music feedeth that disposition of the spirits which it findeth. We see also, that several airs and tunes do please several nations and persons, according to the sympathy they have with their spirits.

Experiments in consort touching sounds; and first touching the nullity and entity of sounds.

Perspective hath been with some diligence enquired; and so hath the nature of sounds, in some sort, as far as concerneth music: but the nature of sounds in general hath been superficially observed. It is one of the subtilest pieces of nature. And besides, I practise, as I do advise; which is, after long enquiry of things immersed in matter, to interpose some subject which is immateriate, or less materiate; such as this of sounds; to the end, that the intellect may be rectified, and become not partial.

115. It is first to be considered, what great motions there are in nature, which pass without sound or noise. The heavens turn about in a most rapid motion, without noise to us perceived; though in some dreams they have been said to make an excellent music. So the motions of the comets, and fiery meteors, as *stella cadens*, *etc.* yield no noise. And if it be thought, that it is the greatness of distance from us, whereby the sound cannot be heard; we see that lightnings and coruscations, which are near at hand, yield no sound neither: and yet in all these, there is a percussion and division of the air. The winds in the upper region, which move the clouds above, which we call the rack, and are not perceived below, pass without noise. The lower winds in a plain, except they be strong, make no noise; but amongst trees,

the noise of such winds will be perceived. And the winds, generally, when they make a noise, do ever make it unequally, rising and falling, and sometimes, when they are vehement, trembling at the height of their blast. Rain or hail falling, though vehemently, yieldeth no noise in passing through the air, till it fall upon the ground, water, houses, or the like. Water in a river, though a swift stream, is not heard in the channel, but runneth in silence, if it be of any depth; but the very stream upon shallows, of gravel, or pebble, will be heard. And waters, when they beat upon the shore, or are straitned, as in the falls of bridges, or are dashed against themselves, by winds, give a roaring noise. Any piece of timber, or hard body, being thrust forwards by another body contiguous, without knocking, giveth no noise. And so bodies in weighing one upon another, though the upper body press the lower body down, make no noise. So the motion in the minute parts of any solid body, which is the principal cause of violent motion, though unobserved, passeth without sound; for that sound that is heard sometimes, is produced only by the breaking of the air; and not by the impulsion of the parts. So it is manifest, that where the anterior body giveth way, as fast as the posterior cometh on, it maketh no noise, be the motion never so great or swift.

116. Air open, and at large, maketh no noise, except it be sharply percussed; as in the sound of a string, where air is percussed by a hard and stiff body, and with a sharp loose: for if the string be not strained, it maketh no noise. But where the air is pent and straitned, there breath or other blowing, which carry but a gentle percussion, suffice to create sound; as in pipes and wind-instruments. But then you must note, that in recorders, which go with a gentle breath, the concave of the pipe, were it not for the fipple that straitneth the air, much more than the simple concave, would yield no sound. For as for other wind-instruments, they require a forcible breath; as trumpets, cornets, hunters horns, *etc.* which appeareth

by the blown cheeks of him that windeth them. Organs also are blown with a strong wind by the bellows. And note again, that some kind of wind-instruments are blown at a small hole in the side, which straitneth the breath at the first entrance; the rather, in respect of their traverse and stop above the hole, which performeth the fipples part; as it is seen in flutes and fifes, which will not give sound by a blast at the end, as recorders, *etc.* do. Likewise in all whistling, you contract the mouth; and to make it more sharp, men sometimes use their finger. But in open air, if you throw a stone or a dart, they give no sound: no more do bullets, except they happen to be a little hollowed in the casting; which hollowness penneth the air: nor yet arrows, except they be ruffled in their feathers, which likewise penneth the air. As for small whistles or shepherds oaten pipes, they give a sound because of their extreme slenderness, whereby the air is more pent, than in a wider pipe. Again, the voices of men and living creatures pass through the throat, which penneth the breath. As for the Jews-harp, it is a sharp percussion; and, besides, hath the advantage of penning the air in the mouth.

117. Solid bodies, if they be very softly percussed, give no sound; as when a man treadeth very softly upon boards. So chests or doors in fair weather, when they open easily, give no sound. And cart-wheels squeak not when they are liquored.

118. The flame of tapers or candles, though it be a swift motion and breaketh the air, yet passeth without sound. Air in ovens, though, no doubt, it doth, as it were, boil and dilate itself, and is repercussed; yet it is without noise.

119. Flame percussed by air, giveth a noise; as in blowing of the fire by bellows; greater than if the bellows should blow upon the air itself. And so likewise flame percussing the air strongly, as when flame suddenly taketh and openeth, giveth a noise; so great flames, while the one impelleth the other, give a bellowing sound.

120. There is a conceit runneth abroad, that there

should be a white powder, which will discharge a piece without noise; which is a dangerous experiment if it should be true: for it may cause secret murders. But it seemeth to me impossible; for, if the air pent be driven forth and strike the air open, it will certainly make a noise. As for the white powder, if any such thing be, that may extinguish or deaden the noise, it is like to be a mixture of petre and sulphur, without coal. For petre alone will not take fire. And if any man think, that the sound may be extinguished or deadened by discharging the pent air, before it cometh to the mouth of the piece and to the open air, that is not probable; for it will make more divided sounds: as if you should make a cross-barrel hollow through the barrel of a piece, it may be it would give several sounds, both at the nose and at the sides. But I conceive, that if it were possible to bring to pass, that there should be no air pent at the mouth of the piece, the bullet might fly with small or no noise. For first it is certain, there is no noise in the percussion of the flame upon the bullet. Next the bullet, in piercing through the air, maketh no noise; as hath been said. And then, if there be no pent air that striketh upon open air, there is no cause of noise; and yet the flying of the bullet will not be stayed. For that motion, as hath been oft said, is in the parts of the bullet, and not in the air. So as trial must be made by taking some small concave of metal, no more than you mean to fill with powder, and laying the bullet in the mouth of it, half out into the open air.

121. I HEARD it affirmed by a man that was a great dealer in secrets, but he was but vain, that there was a conspiracy, which himself hindred, to have killed queen Mary, sister to queen Elizabeth, by a burning-glass, when she walked in Saint James's park, from the leads of the house. But thus much, no doubt, is true; that if burning-glasses could be brought to a great strength, as they talk generally of burning-glasses that are able to burn a navy, the percussion of the air alone, by such a burning-glass, would make

no noise; no more than is found in coruscations and lightnings without thunders.

122. I SUPPOSE, that impression of the air with sounds asketh a time to be conveyed to the sense, as well as the impressing of species visible; or else they will not be heard. And therefore, as the bullet moveth so swift that it is invisible; so the same swiftness of motion maketh it inaudible: for we see, that the apprehension of the eye is quicker than that of the ear.

123. ALL eruptions of air, though small and slight, give an entity of sound, which we call crackling, puffing, spitting, *etc.* as in bay-salt, and bay-leaves, cast into the fire; so in chesnuts, when they leap forth of the ashes; so in green wood laid upon the fire, especially roots; so in candles, that spit flame if they be wet; so in rasping, sneezing, *etc.* so in a rose leaf gathered together into the fashion of a purse, and broken upon the forehead, or back of the hand, as children use.

Experiments in consort touching production, conservation, and dilation of sounds; and the office of the air therein.

124. THE cause given of sound, that it should be an elision of the air, whereby, if they mean any thing, they mean a cutting or dividing, or else an attenuating of the air, is but a term of ignorance; and the notion is but a catch of the wit upon a few instances; as the manner is in the philosophy received. And it is common with men, that if they have gotten a pretty expression by a word of art, that expression goeth current; though it be empty of matter. This conceit of elision appeareth most manifestly to be false, in that the sound of a bell, string, or the like, continueth melting some time after the percussion; but ceaseth straitways, if the bell, or string, be touched and stayed: whereas, if it were the elision of the air that made the sound, it could not be that the touch of the bell or string should extinguish so suddenly that motion caused by the elision of the air. This appeareth yet

more manifestly by chiming with a hammer upon the outside of a bell: for the sound will be according to the inward concave of the bell; whereas the elision or attenuation of the air cannot be but only between the hammer and the outside of the bell. So again, if it were an elision, a broad hammer, and a bodkin, struck upon metal, would give a diverse tone, as well as a diverse loudness: but they do not so; for though the sound of the one be louder, and of the other softer, yet the tone is the same. Besides, in echoes, whereof some are as loud as the original voice, there is no new elision, but a repercussion only. But that which convinceth it most of all is, that sounds are generated where there is no air at all. But these and the like conceits, when men have cleared their understanding by the light of experience, will scatter and break up like a mist.

125. It is certain, that sound is not produced at the first, but with some local motion of the air, or flame, or some other medium; nor yet without some resistance, either in the air or the body percussed. For if there be a mere yielding or cession, it produceth no sound; as hath been said. And therein sounds differ from light and colours, which pass through the air, or other bodies, without any local motion of the air; either at the first, or after. But you must attentively distinguish between the local motion of the air, which is but *vehiculum causæ*, a carrier of the sounds, and the sounds themselves, conveyed in the air. For as to the former, we see manifestly, that no sound is produced, no not by air itself against other air, as in organs, *etc.* but with a perceptible blast of the air; and with some resistance of the air strucken. For even all speech, which is one of the gentlest motions of air, is with expulsion of a little breath. And all pipes have a blast, as well as a sound. We see also manifestly, that sounds are carried with wind: and therefore sounds will be heard further with the wind, than against the wind: and likewise do rise and fall with the intension or remission of the wind. But for the impression of the sound, it is quite another

thing, and is utterly without any local motion of the air, perceptible; and in that resembleth the species visible: for after a man hath lured, or a bell is rung, we cannot discern any perceptible motion at all in the air as the sound goeth along; but only at the first. Neither doth the wind, as far as it carrieth a voice, with the motion thereof, confound any of the delicate and articulate figurations of the air, in variety of words. And if a man speak a good loudness against the flame of a candle, it will not make it tremble much; though most when those letters are pronounced which contract the mouth; as *F*, *S*, *V*, and some others. But gentle breathing, or blowing without speaking, will move the candle far more. And it is the more probable, that sound is without any local motion of the air, because as it differeth from the sight, in that it needeth a local motion of the air at first; so it paralleleth in so many other things with the sight, and radiation of things visible; which, without all question, induce no local motion in the air, as hath been said.

126. Nevertheless it is true, that upon the noise of thunder, and great ordnance, glass windows will shake; and fishes are thought to be frightned with the motion caused by noise upon the water. But these effects are from the local motion of the air, which is a concomitant of the sound, as hath been said, and not from the sound.

127. It hath been anciently reported, and is still received, that extreme applauses and shouting of people assembled in great multitudes, have so rarified and broken the air, that birds flying over have fallen down, the air being not able to support them. And it is believed by some, that great ringing of bells in populous cities hath chased away thunder; and also dissipated pestilent air: all which may be also from the concussion of the air, and not from the sound.

128. A very great sound, near hand, hath strucken many deaf; and at the instant they have found, as it were, the breaking of a skin or parchment in their ear: and myself standing near one that lured loud

and shrill, had suddenly an offence, as if somewhat had broken or been dislocated in my ear; and immediately after a loud ringing, not an ordinary singing or hissing, but far louder and differing, so as I feared some deafness. But after some half quarter of an hour it vanished. This effect may be truly referred unto the sound: for, as is commonly received, an over-potent object doth destroy the sense; and spiritual species, both visible and audible, will work upon the sensories, though they move not any other body.

129. In dilation of sounds, the inclosure of them preserveth them, and causeth them to be heard farther. And we find in rolls of parchment or trunks, the mouth being laid to the one end of the roll of parchment or trunk, and the ear to the other, the sound is heard much farther than in the open air. The cause is, for that the sound spendeth, and is dissipated in the open air; but in such concaves it is conserved and contracted. So also in a piece of ordnance, if you speak in the touchhole, and another lay his ear to the mouth of the piece, the sound passeth and is far better heard than in the open air.

130. It is further to be considered, how it proveth and worketh when the sound is not inclosed all the length of its way, but passeth partly through open air; as where you speak some distance from a trunk; or where the ear is some distance from the trunk at the other end; or where both mouth and ear are distant from the trunk. And it is tried, that in a long trunk of some eight or ten foot, the sound is holpen, though both the mouth and the ear be a handful or more from the ends of the trunk; and somewhat more holpen, when the ear of the hearer is near, than when the mouth of the speaker. And it is certain, that the voice is better heard in a chamber from abroad, than abroad from within the chamber.

131. As the inclosure that is round about and intire, preserveth the sound; so doth a semi-concave, though in a less degree. And therefore, if you divide a trunk, or a cane into two, and one speak at the

one end, and you lay your ear at the other, it will carry the voice further, than in the air at large. Nay further, if it be not a full semi-concave, but if you do the like upon the mast of a ship, or a long pole, or a piece of ordnance, though one speak upon the surface of the ordnance, and not at any of the bores, the voice will be heard further than in the air at large.

132. It would be tried, how, and with what proportion of disadvantage the voice will be carried in an horn, which is a line arched; or in a trumpet, which is a line retorted; or in some pipe that were sinuous.

133. It is certain, howsoever it cross the received opinion, that sounds may be created without air, though air be the most favourable deferent of sounds. Take a vessel of water, and knap a pair of tongs some depth within the water, and you shall hear the sound of the tongs well, and not much diminished; and yet there is no air at all present.

134. Take one vessel of silver and another of wood, and fill each of them full of water, and then knap the tongs together, as before, about an handful from the bottom, and you shall find the sound much more resounding from the vessel of silver, than from that of wood: and yet if there be no water in the vessel, so that you knap the tongs in the air, you shall find no difference between the silver and the wooden vessel. Whereby, beside the main point of creating sound without air, you may collect two things: the one, that the sound communicateth with the bottom of the vessel; the other, that such a communication passeth far better through water than air.

135. Strike any hard bodies together in the midst of a flame; and you shall hear the sound with little difference from the sound in the air.

136. The pneumatical part which is in all tangible bodies, and hath some affinity with the air, performeth, in some degree, the part of the air; as when you knock upon an empty barrel, the sound is in part created by the air on the outside; and in part by the air in the inside: for the sound will be greater or

lesser, as the barrel is more empty or more full; but yet the sound participateth also with the spirit in the wood through which it passeth, from the outside to the inside: and so it cometh to pass in the chiming of bells on the outside; where also the sound passeth to the inside: and a number of other like instances, whereof we shall speak more when we handle the communication of sounds.

137. It were extreme grossness to think, as we have partly touched before, that the sound in strings is made or produced between the hand and the string, or the quill and the string, or the bow and the string, for those are but *vehicula motus*, passages to the creation of the sound, the sound being produced between the string and the air; and that not by any impulsion of the air from the first motion of the string; but by the return or result of the string, which was strained by the touch, to his former place: which motion of result is quick and sharp; whereas the first motion is soft and dull. So the bow tortureth the string continually, and thereby holdeth it in a continual trepidation.

Experiments in consort touching the magnitude and exility and damps of sounds.

138. Take a trunk, and let one whistle at the one end, and hold your ear at the other, and you shall find the sound strike so sharp as you can scarce endure it. The cause is, for that sound diffuseth itself in round, and so spendeth itself; but if the sound, which would scatter in open air, be made to go all into a canal, it must needs give greater force to the sound. And so you may note, that inclosures do not only preserve sound, but also increase and sharpen it.

139. A hunter's horn being greater at one end than at the other, doth increase the sound more than if the horn were all of an equal bore. The cause is, for that the air and sound being first contracted at the lesser end, and afterwards having more room to spread at the greater end, do dilate themselves; and in coming out strike more air; whereby the sound is the greater and baser. And even hunter's horns, which

are sometimes made straight, and not oblique, are ever greater at the lower end. It would be tried also in pipes, being made far larger at the lower end; or being made with a belly towards the lower end, and then issuing into a straight concave again.

140. There is in Saint James's fields a conduit of brick, unto which joineth a low vault; and at the end of that a round house of stone: and in the brick conduit there is a window; and in the round house a slit or rift of some little breadth: if you cry out in the rift, it will make a fearful roaring at the window. The cause is the same with the former; for that all concaves, that proceed from more narrow to more broad, do amplify the sound at the coming out.

141. Hawks bells, that have holes in the sides, give a greater ring, than if the pellet did strike upon brass in the open air. The cause is the same with the first instance of the trunk; namely, for that the sound inclosed with the sides of the bell cometh forth at the holes unspent and more strong.

142. In drums, the closeness round about, that preserveth the sound from dispersing, maketh the noise come forth at the drum-hole far more loud and strong than if you should strike upon the like skin extended in the open air. The cause is the same with the two precedent.

143. Sounds are better heard, and farther off, in an evening or in the night, than at the noon or in the day. The cause is, for that in the day, when the air is more thin, no doubt, the sound pierceth better; but when the air is more thick, as in the night, the sound spendeth and spreadeth abroad less: and so it is a degree of inclosure. As for the night, it is true also that the general silence helpeth.

144. There be two kinds of reflexions of sounds; the one at distance, which is the echo; wherein the original is heard distinctly, and the reflexion also distinctly; of which we shall speak hereafter: the other in concurrence; when the sound reflecting, the reflexion being near at hand, returneth immediately upon the original, and so iterateth it not, but ampli-

fieth it. Therefore we see, that music upon the water soundeth more; and so likewise music is better in chambers wainscotted than hanged.

145. The strings of a lute, or viol, or virginals, do give a far greater sound, by reason of the knot, and board, and concave underneath, than if there were nothing but only the flat of a board, without that hollow and knot, to let in the upper air into the lower. The cause is the communication of the upper air with the lower, and penning of both from expence or dispersing.

146. An Irish harp hath open air on both sides of the strings: and it hath the concave or belly not along the strings, but at the end of the strings. It maketh a more resounding sound than a bandora, orpharion, or cittern, which have likewise wire-strings. I judge the cause to be, for that open air on both sides helpeth, so that there be a concave; which is therefore best placed at the end.

147. In a virginal, when the lid is down, it maketh a more exile sound than when the lid is open. The cause is, for that all shutting in of air, where there is no competent vent, dampeth the sound: which maintaineth likewise the former instance; for the belly of the lute or viol doth pen the air somewhat.

148. There is a church at Gloucester, and, as I have heard, the like is in some other places, where if you speak against a wall softly, another shall hear your voice better a good way off, than near at hand. Inquire more particularly of the frame of that place. I suppose there is some vault, or hollow, or isle, behind the wall, and some passage to it towards the farther end of that wall against which you speak; so as the voice of him that speaketh slideth along the wall, and then entereth at some passage, and communicateth with the air of the hollow; for it is preserved somewhat by the plain wall; but that is too weak to give a sound audible, till it hath communicated with the back air.

149. Strike upon a bow-string, and lay the horn of the bow near your ear, and it will increase the

sound, and make a degree of a tone. The cause is, for that the sensory, by reason of the close holding, is percussed before the air disperseth. The like is, if you hold the horn betwixt your teeth: but that is a plain dilation of the sound from the teeth to the instrument of hearing; for there is a great intercourse between those two parts; as appeareth by this, that a harsh grating tune setteth the teeth on edge. The like falleth out, if the horn of the bow be put upon the temples; but that is but the slide of the sound from thence to the ear.

150. If you take a rod of iron or brass, and hold the one end to your ear, and strike upon the other, it maketh a far greater sound than the like stroke upon the rod, made not so contiguous to the ear. By which, and by some other instances that have been partly touched, it should appear, that sounds do not only slide upon the surface of a smooth body, but do also communicate with the spirits, that are in the pores of the body.

151. I remember in Trinity College in Cambridge, there was an upper chamber, which being thought weak in the roof of it, was supported by a pillar of iron of the bigness of one's arm in the midst of the chamber; which if you had struck, it would make a little flat noise in the room where it was struck, but it would make a great bomb in the chamber beneath.

152. The sound which is made by buckets in a well, when they touch upon the water, or when they strike upon the side of the well, or when two buckets dash the one against the other, these sounds are deeper and fuller than if the like percussion were made in the open air. The cause is the penning and inclosure of the air in the concave of the well.

153. Barrels placed in a room under the floor of a chamber, make all noises in the same chamber more full and resounding.

So that there be five ways, in general, of majoration of sounds: inclosure simple; inclosure with dilatation; communication; reflexion concurrent; and approach to the sensory.

154. For exility of the voice or other sounds; it is certain that the voice doth pass through solid and hard bodies if they be not too thick: and through water, which is likewise a very close body, and such an one as letteth not in air. But then the voice, or other sound, is reduced by such passage to a great weakness or exility. If therefore you stop the holes of a hawk's bell, it will make no ring, but a flat noise or rattle. And so doth the *aëtites* or eagle-stone, which hath a little stone within it.

155. And as for water, it is a certain trial: let a man go into a bath, and take a pail, and turn the bottom upward, and carry the mouth of it even down to the level of the water, and so press it down under the water some handful and an half, still keeping it even, that it may not tilt on either side, and so the air get out; then let him that is in the bath dive with his head so far under water, as he may put his head into the pail, and there will come as much air bubbling forth, as will make room for his head. Then let him speak, and any that shall stand without shall hear his voice plainly; but yet made extreme sharp and exile, like the voice of puppets: but yet the articulate sounds of the words will not be confounded. Note, that it may be much more handsomely done, if the pail be put over the man's head above water, and then he cowr down, and the pail be pressed down with him. Note, that a man must kneel or sit, that he may be lower than the water. A man would think that the Sicilian poet had knowledge of this experiment; for he saith, that Hercules's page, Hylas, went with a water-pot to fill it at a pleasant fountain that was near the shore, and that the nymphs of the fountain fell in love with the boy, and pulled him under water, keeping him alive; and that Hercules missing his page, called him by his name aloud, that all the shore rang of it; and that Hylas from within the water answered his master, but, that which is to the present purpose, with so small and exile a voice, as Hercules thought he had been three miles off, when the fountain, indeed, was fast by.

156. In lutes and instruments of strings, if you stop a string high, whereby it hath less scope to tremble, the sound is more treble, but yet more dead.

157. Take two saucers, and strike the edge of the one against the bottom of the other, within a pail of water; and you shall find, that as you put the saucers lower and lower, the sound groweth more flat; even while part of the saucer is above the water; but that flatness of sound is joined with a harshness of sound; which no doubt is caused by the inequality of the sound which cometh from the part of the saucer under the water and from the part above. But when the saucer is wholly under the water the sound becometh more clear, but far more low, and as if the sound came from afar off.

158. A soft body dampeth the sound much more than a hard; as if a bell hath cloth or silk wrapped about it, it deadneth the sound more than if it were wood. And therefore in clericals the keys are lined; and in colleges they use to line the tablemen.

159. Trial was made in a recorder after these several manners. The bottom of it was set against the palm of the hand; stopped with wax round about; set against a damask cushion; thrust into sand; into ashes; into water, half an inch under the water; close to the bottom of a silver bason; and still the tone remained: but the bottom of it was set against a woollen carpet; a lining of plush; a lock of wool, though loosely put in; against snow; and the sound of it was quite deadned, and but breath.

160. Iron hot produceth not so full a sound as when it is cold; for while it is hot, it appeareth to be more soft and less resounding. So likewise warm water, when it falleth, maketh not so full a sound as cold; and I conceive it is softer, and nearer the nature of oil; for it is more slippery, as may be perceived in that it scowreth better.

161. Let there be a recorder made with two fipples, at each end one; the trunk of it of the length of two recorders, and the holes answerable towards each end; and let two play the same lesson upon

it at an unison; and let it be noted whether the sound be confounded, or amplified, or dulled. So likewise let a cross be made of two trunks hollow throughout; and let two speak, or sing, the one longways, the other traverse: and let two hear at the opposite ends; and note whether the sound be confounded, amplified, or dulled. Which two instances will also give light to the mixture of sounds, whereof we shall speak hereafter.

162. A BELLOWS blown in at the hole of a drum, and the drum then srrucken, maketh the sound a little flatter, but no other apparent alteration. The cause is manifest; partly for that it hindereth the issue of the sound; and partly for that it maketh the air, being blown together, less moveable.

Experiments in consort touching the loudness or softness of sounds, and their carriage at longer or shorter distance.

163. THE loudness and softness of sounds is a thing distinct from the magnitude and exility of sounds; for a base string, though softly strucken, giveth the greater sound; but a treble string, if hard strucken, will be heard much farther off. And the cause is, for that the base string striketh more air, and the treble less air, but with a sharper percussion.

164. IT is therefore the strength of the percussion, that is a principal cause of the loudness or softness of sounds; as in knocking harder or softer; winding of a horn stronger or weaker; ringing of a hand-bell harder or softer, *etc.* And the strength of this percussion consisteth as much or more in the hardness of the body percussed, as in the force of the body percussing: for if you strike against a cloth, it will give a less sound; if against wood, a greater; if against metal, yet a greater; and in metals, if you strike against gold, which is the more pliant, it giveth the flatter sound; if against silver or brass, the more ringing sound. As for air, where it is strongly pent, it matcheth a hard body. And therefore we see in discharging of a piece, what a great noise it maketh.

We see also, that the charge with bullet, or with paper wet and hard stopped, or with powder alone rammed in hard, maketh no great difference in the loudness of the report.

165. The sharpness or quickness of the percussion, is a great cause of the loudness, as well as the strength; as in a whip or wand, if you strike the air with it; the sharper and quicker you strike it, the louder sound it giveth. And in playing upon the lute or virginals, the quick stroke or touch is a great life to the sound. The cause is, for that the quick striking cutteth the air speedily; whereas the soft striking doth rather beat than cut.

Experiments in consort touching the communication of sounds.

The communication of sounds, as in bellies of lutes, empty vessels, *etc.* hath been touched *obiter* in the majoration of sounds; but it is fit also to make a title of it apart.

166. The experiment for greatest demonstration of communication of sounds, is the chiming of bells; where if you strike with a hammer upon the upper part, and then upon the midst, and then upon the lower, you shall find the sound to be more treble and more base, according to the concave on the inside, though the percussion be only on the outside.

167. When the sound is created between the blast of the mouth and the air of the pipe, it hath nevertheless some communication with the matter of the sides of the pipe, and the spirits in them contained; for in a pipe, or trumpet, of wood, and brass, the sound will be diverse; so if the pipe be covered with cloth or silk, it will give a diverse sound from what it would do of itself; so if the pipe be a little wet on the inside, it will make a differing sound from the same pipe dry.

168. That sound made within water doth communicate better with a hard body through water, than made in air it doth with air, *vide experimentum* 134.

Experiments in consort touching equality and inequality of sounds.

We have spoken before, in the inquisition touching music, of musical sounds, whereunto there may be a concord or discord in two parts; which sounds we call tones: and likewise of immusical sounds; and have given the cause, that the tone proceedeth of equality, and the other of inequality. And we have also expressed there, what are the equal bodies that give tones, and what are the unequal that give none. But now we shall speak of such inequality of sounds, as proceedeth not from the nature of the bodies themselves, but as accidental; either from the roughness or obliquity of the passage, or from the doubling of the percutient, or from the trepidation of the motion.

169. A bell, if it have a rift in it, whereby the sound hath not a clear passage, giveth a hoarse and jarring sound; so the voice of man, when by cold taken the weasand groweth rugged, and, as we call it, furred, becometh hoarse. And in these two instances the sounds are ingrate, because they are merely unequal: but if they be unequal in equality, then the sound is grateful, but purling.

170. All instruments that have either returns, as trumpets; or flexions, as cornets; or are drawn up, and put from, as sackbuts; have a purling sound: but the recorder, or flute, that has none of these inequalities, gives a clear sound. Nevertheless, the recorder itself, or pipe, moistened a little in the inside, soundeth more solemnly, and with a little purling or hissing. Again, a wreathed string, such as are in the base strings of bandoras, giveth also a purling sound.

171. But a lute-string, if it be merely unequal in its parts, giveth a harsh and untunable sound; which strings we call false, being bigger in one place than in another; and therefore wire strings are never false. We see also, that when we try a false lute-string, we use to extend it hard between the fingers, and to fillip it; and if it giveth a double species, it is true; but if it giveth a treble, or more, it is false.

172. Waters, in the noise they make as they run, represent to the ear a trembling noise; and in regals, where they have a pipe they call the nightingale-pipe, which containeth water, the sound hath a continual trembling: and children have also little things they call cocks, which have water in them; and when they blow or whistle in them, they yield a trembling noise; which trembling of water hath an affinity with the letter *L*. All which inequalities of trepidation are rather pleasant than otherwise.

173. All base notes, or very treble notes, give an asper sound; for that the base striketh more air, than it can well strike equally: and the treble cutteth the air so sharp, as it returneth too swift to make the sound equal: and therefore a mean or tenor is the sweetest part.

174. We know nothing that can at pleasure make a musical or immusical sound by voluntary motion, but the voice of man and birds. The cause is, no doubt, in the weasand or wind-pipe, which we call *aspera arteria*, which being well extended, gathereth equality; as a bladder that is wrinkled, if it be extended, becometh smooth. The extension is always more in tones than in speech: therefore the inward voice or whisper can never give a tone. And in singing, there is, manifestly, a greater working and labour of the throat, than in speaking; as appeareth in the thrusting out or drawing in of the chin, when we sing.

175. The humming of bees is an unequal buzzing, and is conceived by some of the ancients not to come forth at their mouth, but to be an inward sound; but, it may be, it is neither; but from the motion of their wings; for it is not heard but when they stir.

176. All metals quenched in water give a sibilation or hissing sound, which hath an affinity with the letter *Z*, notwithstanding the sound be created between the water or vapour, and the air. Seething also, if there be but small store of water in a vessel, giveth a hissing sound; but boiling in a full vessel giveth a bubbling sound, drawing somewhat near to the cocks used by children.

177. Trial should be made, whether the inequality or interchange of the medium will not produce an inequality of sound; as if three bells were made one within another, and air betwixt each; and then the outermost bell were chimed with a hammer, how the sound would differ from a simple bell. So likewise take a plate of brass, and a plank of wood, and join them close together, and knock upon one of them, and see if they do not give an unequal sound. So make two or three partitions of wood in a hogshead, with holes or knots in them; and mark the difference of their sound from the sound of an hogshead without such partitions.

Experiments in consort touching the more treble, and the more base tones, or musical sounds.

178. It is evident, that the percussion of the greater quantity of air causeth the baser sound; and the less quantity the more treble sound. The percussion of the greater quantity of air is produced by the greatness of the body percussing; by the latitude of the concave by which the sound passeth; and by the longitude of the same concave. Therefore we see that a base string is greater than a treble: a base pipe hath a greater bore than a treble; and in pipes, and the like, the lower the note-holes be, and the further off from the mouth of the pipe, the more base sound they yield; and the nearer the mouth, the more treble. Nay more, if you strike an entire body, as an andiron of brass, at the top, it maketh a more treble sound; and at the bottom a baser.

179. It is also evident, that the sharper or quicker percussion of air causeth the more treble sound; and the slower or heavier, the more base sound. So we see in strings; the more they are wound up and strained, and thereby give a more quick start-back, the more treble is the sound; and the slacker they are, or less wound up, the baser is the sound. And therefore a bigger string more strained, and a lesser string less strained, may fall into the same tone.

180. Children, women, eunuchs, have more small

and shrill voices than men. The reason is, not for that men have greater heat, which may make the voice stronger, for the strength of a voice or sound doth make a difference in the loudness or softness, but not in the tone, but from the dilatation of the organ; which, it is true, is likewise caused by heat. But the cause of changing the voice at the years of puberty, is more obscure. It seemeth to be, for that when much of the moisture of the body, which did before irrigate the parts, is drawn down to the spermatical vessels, it leaveth the body more hot than it was; whence cometh the dilatation of the pipes: for we see plainly all effects of heat do then come on; as pilosity, more roughness of the skin, hardness of the flesh; *etc.*

181. The industry of the musician hath produced two other means of straining or intension of strings, besides their winding up. The one is the stopping of the string with the finger; as in the necks of lutes, viols, *etc.* The other is the shortness of the string, as in harps, virginals, *etc.* Both these have one and the same reason; for they cause the string to give a quicker start.

182. In the straining of a string, the further it is strained, the less superstraining goeth to a note; for it requireth good winding of a string before it will make any note at all: and in the stops of lutes, *etc.* the higher they go, the less distance is between the frets.

183. If you fill a drinking-glass with water, especially one sharp below, and wide above, and fillip upon the brim or outside; and after empty part of the water, and so more and more, and still try the tone by filliping; you shall find the tone fall and be more base, as the glass is more empty.

Experiments in consort touching the proportion of treble and base tones.

The just and measured proportion of the air percussed, towards the baseness or trebleness of tones, is one of the greatest secrets in the contemplation

of sounds. For it discovereth the true coincidence of tones into diapasons; which is the return of the same sound. And so of the concords and discords between the unison and diapason, which we have touched before in the experiments of music; but think fit to resume it here as a principal part of our inquiry touching the nature of sounds. It may be found out in the proportion of the winding of strings; in the proportion of the distance of frets; and in the proportion of the concave of pipes, *etc.* but most commodiously in the last of these.

184. Try therefore the winding of a string once about, as soon as it is brought to that extension as will give a tone; and then of twice about, and thrice about, *etc.* and mark the scale or difference of the rise of the tone: whereby you shall discover, in one, two effects; both the proportion of the sound towards the dimension of the winding; and the proportion likewise of the sound towards the string, as it is more or less strained. But note that to measure this, the way will be, to take the length in a right line of the string, upon any winding about of the peg.

185. As for the stops, you are to take the number of frets; and principally the length of the line, from the first stop of the string, unto such a stop as shall produce a diapason to the former stop upon the same string.

186. But it will best, as it is said, appear in the bores of wind instruments: and therefore cause some half dozen pipes to be made, in length and all things else alike, with a single, double, and so on to a sextuple bore; and so mark what fall of tone every one giveth. But still in these three last instances, you must diligently observe, what length of string, or distance of stop, or concave of air, maketh what rise of sound. As in the last of these, which, as we said, is that which giveth the aptest demonstration, you must set down what increase of concave goeth to the making of a note higher; and what of two notes; and what of three notes; and so up to the diapason: for then the great secret of numbers and proportions

will appear. It is not unlike that those that make recorders, *etc.* know this already: for that they make them in sets: and likewise bell-founders, in fitting the tune of their bells. So that inquiry may save trial. Surely it hath been observed by one of the anci nts, that an empty barrel knocked upon with the finger, giveth a diapason to the sound of the like barrel full; but how that should be I do not well understand; for that the knocking of a barrel full or empty, doth scarce give any tone.

187. There is required some sensible difference in the proportion of creating a note, towards the sound itself, which is the passive: and that it be not too near, but at a distance. For in a recorder, the three uppermost holes yield one tone; which is a note lower than the tone of the first three. And the like, no doubt, is required in the winding or stopping of strings.

Experiments in consort touching exterior and interior sounds.

There is another difference of sounds, which we will call exterior and interior. It is not soft nor loud: nor it is not base nor treble: nor it is not musical nor immusical: though it be true, that there can be no tone in an interior sound; but on the other side, in an exterior sound there may be both musical and immusical. We shall therefore enumerate them, rather than precisely distinguish them; though, to make some adumbration of that we mean, the interior is rather an impulsion or concussion of the air, than an elision or section of the same: so as the percussion of the one towards the other differeth as a blow differeth from a cut.

188. In speech of man, the whispering, which they call *susurrus* in latin, whether it be louder or softer, is an interior sound; but the speaking out is an exterior sound; and therefore you can never make a tone, nor sing in whispering; but in speech you may: so breathing, or blowing by the mouth, bellows, or wind, though loud, is an interior sound; but

the blowing through a pipe or concave, though soft, is an exterior. So likewise the greatest winds, if they have no coarctation, or blow not hollow, give an interior sound; the whistling or hollow wind yieldeth a singing, or exterior sound; the former being pent by some other body; the latter being pent in by its own density: and therefore we see, that when the wind bloweth hollow, it is a sign of rain. The flame, as it moveth within itself or is blown by a bellows, giveth a murmur or interior sound.

189. There is no hard body, but struck against another hard body, will yield an exterior sound greater or lesser: insomuch as if the percussion be over-soft, it may induce a nullity of sound; but never an interior sound; as when one treadeth so softly that he is not heard.

190. Where the air is the percutient, pent or not pent, against a hard body, it never giveth an exterior sound; as if you blow strongly with a bellows against a wall.

191. Sounds, both exterior and interior, may be made as well by suction as by emission of the breath: as in whistling or breathing.

Experiments in consort touching articulation of sounds.

192. It is evident, and it is one of the strangest secrets in sounds, that the whole sound is not in the whole air only; but the whole sound is also in every small part of the air. So that all the curious diversity of articulate sounds, of the voice of man or birds, will enter at a small cranny inconfused.

193. The unequal agitation of the winds and the like, though they be material to the carriage of the sounds farther or less way; yet they do not confound the articulation of them at all, within that distance that they can be heard; though it may be, they make them to be heard less way than in a still; as hath been partly touched.

194. Over-great distance confoundeth the articulation of sounds; as we see, that you may hear the sound of a preacher's voice, or the like, when you

cannot distinguish what he saith. And one articulate sound will confound another, as when many speak at once.

195. In the experiment of speaking under water, when the voice is reduced to such an extreme exility, yet the articulate sounds, which are the words, are not confounded, as hath been said.

196. I conceive, that an extreme small or an extreme great sound cannot be articulate; but that the articulation requireth a mediocrity of sound: for that the extreme small sound confoundeth the articulation by contracting; and the great sound by dispersing: and although, as was formerly said, a sound articulate, already created, will be contracted into a small cranny; yet the first articulation requireth more dimension.

197. It hath been observed, that in a room, or in a chapel, vaulted below and vaulted likewise in the roof, a preacher cannot be heard so well, as in the like places, not so vaulted. The cause is, for that the subsequent words come on before the precedent words vanish: and therefore the articulate sounds are more confused, though the gross of the sound be greater.

198. The motions of the tongue, lips, throat, palate, *etc.* which go to the making of the several alphabetical letters, are worthy inquiry, and pertinent to the present inquisition of sounds: but because they are subtle and long to describe, we will refer them over, and place them amongst the experiments of speech. The Hebrews have been diligent in it, and have assigned which letters are labial, which dental, which guttural, *etc.* As for the Latins and Grecians, they have distinguished between semi-vowels and mutes; and in mutes between *mutæ tenues*, *mediæ*, and *aspiratæ;* not amiss, but yet not diligently enough. For the special strokes and motions that create those sounds, they have little inquired: as, that the letters *B, P, F, M,* are not expressed, but with the contracting or shutting of the mouth; that the letters *N* and *B,* cannot be pronounced but that the

letter *N* will turn into *M;* as *hecatonba* will be *hecatomba*. That *M* and *T* cannot be pronounced together, but *P* will come between; as *emtus* is pronounced *emptus;* and a number of the like. So that if you inquire to the full, you will find, that to the making of the whole alphabet there will be fewer simple motions required than there are letters.

199. The lungs are the most spungy part of the body; and therefore ablest to contract and dilate itself; and where it contracteth itself, it expelleth the air; which through the artery, throat, and mouth, maketh the voice: but yet articulation is not made but with the help of the tongue, palate, and the rest of those they call instruments of voice.

200. There is found a similitude between the sound that is made by inanimate bodies or by animate bodies that have no voice articulate, and divers letters of articulate voices: and commonly men have given such names to those sounds, as do allude unto the articulate letters; as trembling of water hath resemblance with the letter *L;* quenching of hot metals with the letter *Z;* snarling of dogs with the letter *R;* the noise of screech-owls with the letter *Sh;* voice of cats with the diphthong *Eu;* voice of cuckows with the diphthong *Ou;* sounds of strings with the letter *Ng:* so that if a man, for curiosity or strangeness sake, would make a puppet or other dead body to pronounce a word, let him consider, on the one part, the motion of the instrument of voice; and on the other part, the like sounds made in inanimate bodies; and what conformity there is that causeth the similitude of sounds; and by that he may minister light to that effect.

NATURAL HISTORY.

CENTURY III.

Experiments in consort touching the motions of sounds, in what lines they are circular, oblique, straight, upwards, downwards, forwards, backwards.

201. ALL sounds whatsoever move round; that is to say, on all sides; upwards, downwards, forwards, and backwards. This appeareth in all instances.

202. SOUNDS do not require to be conveyed to the sense in a right line, as visibles do, but may be arched; though it be true, they move strongest in a right line; which nevertheless is not caused by the rightness of the line, but by the shortness of the distance; *linea recta brevissima*. And therefore we see if a wall be between, and you speak on the one side, you hear it on the other; which is not because the sound passeth through the wall, but archeth over the wall.

203. IF the sound be stopped and repercussed, it cometh about on the other side in an oblique line. So, if in a coach one side of the boot be down, and the other up, and a beggar beg on the close side; you will think that he were on the open side. So likewise, if a bell or clock be, for example, on the north side of a chamber, and the window of that chamber be upon the south; he that is in the chamber will think the sound came from the south.

204. SOUNDS, though they spread round, so that there is an orb or spherical area of the sound, yet they move strongest and go farthest in the fore-lines, from the first local impulsion of the air. And therefore in preaching, you shall hear the preacher's voice better before the pulpit, than behind it, or on the sides, though it stand open. So a harquebus, or

ordnance, will be farther heard forwards from the mouth of the piece, than backwards or on the sides.

205. It may be doubted, that sounds do move better downwards than upwards. Pulpits are placed high above the people. And when the ancient generals spake to their armies, they had ever a mount of turf cast up, whereupon they stood; but this may be imputed to the stops and obstacles which the voice meeteth with, when one speaketh upon the level. But there seemeth to be more in it; for it may be that spiritual species, both of things visible and sounds, do move better downwards than upwards. It is a strange thing, that to men standing below on the ground, those that be on the top of Paul's seem much less than they are, and cannot be known; but to men above, those below seem nothing so much lessened, and may be known: yet it is true, that all things to them above seem also somewhat contracted, and better collected into figure: as knots in gardens shew best from an upper window or terras.

206. But to make an exact trial of it, let a man stand in a chamber not much above the ground, and speak out at the window, through a trunk, to one standing on the ground, as softly as he can, the other laying his ear close to the trunk: then *via versa*, let the other speak below, keeping the same proportion of softness; and let him in the chamber lay his ear to the trunk: and this may be the aptest means to make a judgment, whether sounds descend or ascend better.

Experiments in consort touching the lasting and perishing of sounds; and touching the time they require to their generation or dilation.

207. After that sound is created, which is in a moment, we find it continueth some small time, melting by little and little. In this there is a wonderful error amongst men, who take this to be a continuance of the first sound; whereas, in truth, it is a renovation, and not a continuance; for the body percussed hath, by reason of the percussion, a trepi-

dation wrought in the minute parts, and so reneweth the percussion of the air. This appeareth manifestly, because that the melting sound of a bell, or of a string strucken, which is thought to be a continuance, ceaseth as soon as the bell or string is touched. As in a virginal, as soon as ever the jack falleth, and toucheth the string, the sound ceaseth; and in a bell, after you have chimed upon it, if you touch the bell the sound ceaseth. And in this you must distinguish that there are two trepidations: the one manifest and local; as of the bell when it is pensile: the other secret of the minute parts; such as is described in the ninth instance. But it is true, that the local helpeth the secret greatly. We see likewise that in pipes, and other wind-instruments, the sound lasteth no longer than the breath bloweth. It is true, that in organs there is a confused murmur for a while after you have played; but that is but while the bellows are in falling.

208. It is certain, that in the noise of great ordnance, where many are shot off together, the sound will be carried, at the least, twenty miles upon the land, and much farther upon the water. But then it will come to the ear, not in the instant of the shooting off, but it will come an hour or more later. This must needs be a continuance of the first sound; for there is no trepidation which should renew it. And the touching of the ordnance would not extinguish the sound the sooner: so that in great sounds the continuance is more than momentary.

209. To try exactly the time wherein sound is dilated, let a man stand in a steeple, and have with him a taper; and let some vail be put before the taper; and let another man stand in the field a mile off. Then let him in the steeple strike the bell; and in the same instant withdraw the vail; and so let him in the field tell by his pulse what distance of time there is between the light seen, and the sound heard: for it is certain that the dilation of light is in an instant. This may be tried in far greater distances, allowing greater lights and sounds.

210. It is generally known and observed that light, and the object of sight, move swifter than sound: for we see the flash of a piece is seen sooner than the noise is heard. And in hewing wood, if one be some distance off, he shall see the arm lifted up for a second stroke, before he hears the noise of the first. And the greater the distance, the greater is the prevention: as we see in thunder which is far off, where the lightning precedeth the crack a good space.

211. Colours, when they represent themselves to the eye, fade not, nor melt not by degrees, but appear still in the same strength; but sounds melt and vanish by little and little. The cause is, for that colours participate nothing with the motion of the air, but sounds do. And it is a plain argument, that sound participateth of some local motion of the air, as a cause *sine qua non*, in that it perisheth so suddenly; for in every suction or impulsion of the air, the air doth suddenly restore and reunite itself; which the water also doth, but nothing so swiftly.

Experiments in consort touching the passage and interception of sounds.

In the trials of the passage, or not passage of sounds, you must take heed you mistake not the passing by the sides of a body, for the passing through a body; and therefore you must make the intercepting body very close; for sound will pass through a small chink.

212. Where sound passeth through a hard or close body, as through water; through a wall, through metal, as in hawks bells stopped, *etc.* the hard or close body must be but thin and small; for else it deadeneth and extinguisheth the sound utterly. And therefore in the experiment of speaking in air under water, the voice must not be very deep within the water: for then the sound pierceth not. So if you speak on the farther side of a close wall, if the wall be very thick you shall not be heard: and if there were an hogshead empty, whereof the sides were some two foot thick, and the bunghole stopped; I conceive the resounding sound, by the communica-

tion of the outward air with the air within, would be little or none: but only you shall hear the noise of the outward knock, as if the vessel were full.

213. It is certain, that in the passage of sounds through hard bodies the spirit or pneumatical part of the hard body itself doth co-operate; but much better when the sides of that hard body are struck, than when the percussion is only within, without touch of the sides. Take therefore a hawk's bell, the holes stopped up, and hang it by a thread within a bottle glass, and stop the mouth of the glass very close with wax; and then shake the glass, and see whether the bell give any sound at all, or how weak: but note, that you must instead of the thread take a wire; or else let the glass have a great belly; lest when you shake the bell, it dash upon the sides of the glass.

214. It is plain, that a very long and downright arch for the sound to pass, will extinguish the sound quite; so that that sound, which would be heard over a wall, will not be heard over a church; nor that sound, which will be heard if you stand some distance from the wall, will be heard if you stand close under the wall.

215. Soft and foraminous bodies, in the first creation of the sound, will deaden it; for the striking against cloth or furr will make little sound; as hath been said: but in the passage of the sound, they will admit it better than harder bodies; as we see, that curtains and hangings will not stay the sound much; but glass windows, if they be very close, will check a sound more than the like thickness of cloth. We see also in the rumbling of the belly, how easily the sound passeth through the guts and skin.

216. It is worthy the inquiry, whether great sounds, as of ordnance or bells, become not more weak and exile when they pass through small crannies. For the subtilties of articulate sounds, it may be, may pass through small crannies not confused; but the magnitude of the sound, perhaps, not so well.

Experiments in consort touching the medium of sounds.

217. The medium of sounds is air; soft and porous bodies; also water. And hard bodies refuse not altogether to be mediums of sounds. But all of them are dull and unapt deferents, except the air.

218. In air, the thinner or drier air carrieth not the sound so well as the more dense; as appeareth in night sounds and evening sounds, and sounds in moist weather and southern winds. The reason is already mentioned in the title of majoration of sounds; being for that thin air is better pierced; but thick air preserveth the sound better from waste: let further trial be made by hollowing in mists and gentle showers; for, it may be, that will somewhat deaden the sound.

219. How far forth flame may be a medium of sounds, especially of such sounds as are created by air, and not betwixt hard bodies, let it be tried in speaking where a bonfire is between; but then you must allow for some disturbance the noise that the flame itself maketh.

220. Whether any other liquors, being made mediums, cause a diversity of sound from water, it may be tried: as by the knapping of the tongs; or striking of the bottom of a vessel, filled either with milk or with oil; which though they be more light, yet are they more unequal bodies than air.

Of the natures of the mediums we have now spoken; as for the disposition of the said mediums, it doth consist in the penning, or not penning of the air; of which we have spoken before in the title of dilation of sounds: it consisteth also in the figure of the concave through which it passeth; of which we will speak next.

Experiments in consort, what the figures of the pipes, or concaves, or the bodies deferent, conduce to the sounds.

How the figures of pipes, or concaves, through which sounds pass, or of other bodies deferent, conduce to the variety and alteration of the sounds; either in respect of the greater quantity, or less quantity of air,

which the concaves receive; or in respect of the carrying of sounds longer and shorter way; or in respect of many other circumstances; they have been touched, as falling into other titles. But those figures which we now are to speak of, we intend to be, as they concern the lines through which the sound passeth; as straight, crooked, angular, circular, *etc.*

221. The figure of a bell partaketh of the pyramis, but yet coming off and dilating more suddenly. The figure of a hunter's horn and cornet, is oblique; yet they have likewise straight horns; which if they be of the same bore with the oblique, differ little in sound, save that the straight require somewhat a stronger blast. The figures of recorders, and flutes, and pipes, are straight; but the recorder hath a less bore and a greater, above and below. The trumpet hath the figure of the letter *S:* which maketh that purling sound, *etc.* Generally the straight line hath the cleanest and roundest sound, and the crooked, the more hoarse and jarring.

222. Of a sinuous pipe that may have some four flexions, trial should be made. Likewise of a pipe made like a cross, open in the midst. And so likewise of an angular pipe: and see what will be the effects of these several sounds. And so again of a circular pipe; as if you take a pipe perfectly round, and make a hole whereinto you shall blow, and another hole not far from that; but with a traverse or stop between them; so that your breath may go the round of the circle, and come forth at the second hole. You may try likewise percussions of solid bodies of several figures; as globes, flats, cubes, crosses, triangles, *etc.* and their combinations, as flat against flat, and convex against convex, and convex against flat, *etc.* and mark well the diversities of the sounds. Try also the difference in sound of several crassitudes of hard bodies percussed; and take knowledge of the diversities of the sounds. I myself have tried, that a bell of gold yieldeth an excellent sound, not inferior to that of silver or brass, but rather better: yet we see that a piece of money of gold soundeth far more flat than a piece of money of silver.

223. The harp hath the concave not along the strings, but across the strings; and no instrument hath the sound so melting and prolonged, as the Irish harp. So as I suppose, that if a virginal were made with a double concave, the one all the length, as the virginal hath; the other at the end of the strings, as the harp hath; it must needs make the sound perfecter, and not so shallow and jarring. You may try it without any sound-board along, but only harp-wise, at one end of the strings; or lastly, with a double concave, at each end of the strings one.

Experiments in consort touching the mixture of sounds.

224. There is an apparent diversity between the species visible and audible in this, that the visible doth not mingle in the medium, but the audible doth. For if we look abroad, we see heaven, a number of stars, trees, hills, men, beasts, at once. And the species of the one doth not confound the other. But if so many sounds came from several parts, one of them would utterly confound the other. So we see, that voices or consorts of music do make an harmony by mixture, which colours do not. It is true nevertheless, that a great light drowneth a smaller that it cannot be seen; as the sun that of a glow-worm; as well as a great sound drowneth a lesser. And I suppose likewise, that if there were two lanthorns of glass, the one a crimson, and the other an azure, and a candle within either of them, those coloured lights would mingle, and cast upon a white paper a purple colour. And even in colours, they yield a faint and weak mixture: for white walls make rooms more lightsome than black, *etc.* but the cause of the confusion in sounds, and the inconfusion in species visible, is, for that the sight worketh in right lines, and maketh several cones; and so there can be no coincidence in the eye or visual point: but sounds, that move in oblique and arcuate lines, must needs encounter and disturb the one the other.

225. The sweetest and best harmony is, when every part or instrument is not heard by itself, but a

conflation of them all; which requireth to stand some distance off, even as it is in the mixture of perfumes; or the taking of the smells of several flowers in the air.

226. The disposition of the air in other qualities, except it be joined with sound, hath no great operation upon sounds: for whether the air be lightsome or dark, hot or cold, quiet or stirring, except it be with noise, sweet-smelling, or stinking, or the like; it importeth not much; some petty alteration or difference it may make.

227. But sounds do disturb and alter the one the other: sometimes the one drowning the other, and making it not heard; sometimes the one jarring and discording with the other, and making a confusion; sometimes the one mingling and compounding with the other, and making an harmony.

228. Two voices of like loudness will not be heard twice as far as one of them alone; and two candles of like light, will not make things seen twice as far off as one. The cause is profound; but it seemeth that the impressions from the objects of the senses do mingle respectively, every one with his kind; but not in proportion, as is before demonstrated: and the reason may be, because the first impression, which is from privative to active, as from silence to noise, or from darkness to light, is a greater degree than from less noise to more noise, or from less light to more light. And the reason of that again may be, for that the air, after it hath received a charge, doth not receive a surcharge, or greater charge, with like appetite as it doth the first charge. As for the increase of virtue, generally, what proportion it beareth to the increase of the matter, it is a large field, and to be handled by itself.

Experiments in consort touching melioration of sounds.

229. All reflexions concurrent do make sounds greater; but if the body that createth either the original sound, or the reflexion, be clean and smooth, it maketh them sweeter. Trial may be made of a lute

or viol, with the belly of polished brass instead of wood. We see that even in the open air, the wire-string is sweeter than the string of guts. And we see that for reflexion water excelleth; as in music near the water, or in echos.

230. It hath been tried, that a pipe a little moistened on the inside, but yet so as there be no drops left, maketh a more solemn sound, than if the pipe were dry: but yet with a sweet degree of sibilation or purling; as we touched it before in the title of equality. The cause is, for that all things porous being superficially wet, and, as it were, between dry and wet, become a little more even and smooth; but the purling, which must needs proceed of inequality, I take to be bred between the smoothness of the inward surface of the pipe, which is wet, and the rest of the wood of the pipe unto which the wet cometh not, but it remaineth dry.

231. In frosty weather, music within doors soundeth better. Which may be by reason not of the disposition of the air, but of the wood or string of the instrument, which is made more crisp, and so more porous and hollow: and we see that old lutes sound better than new for the same reason. And so do lute-strings that have been kept long.

232. Sound is likewise meliorated by the mingling of open air with pent air; therefore trial may be made of a lute or viol with a double belly; making another belly with a knot over the strings; yet so, as there be room enough for the strings, and room enough to play below that belly. Trial may be made also of an Irish harp, with a concave on both sides; whereas it useth to have it but on one side. The doubt may be, lest it should make too much resounding; whereby one note would overtake another.

233. If you sing in the hole of a drum, it maketh the singing more sweet. And so I conceive it would, if it were a song in parts sung into several drums; and for handsomeness and strangeness sake, it would not be amiss to have a curtain between the place where the drums are and the hearers.

234. When a sound is created in a wind-instrument between the breath and the air, yet if the sound be communicated with a more equal body of the pipe, it meliorateth the sound. For, no doubt, there would be a differing sound in a trumpet or pipe of wood; and again in a trumpet or pipe of brass. It were good to try recorders and hunters horns of brass, what the sound would be.

235. Sounds are meliorated by the intention of the sense, where the common sense is collected most to the particular sense of hearing, and the sight suspended: and therefore sounds are sweeter, as well as greater, in the night than in the day; and I suppose they are sweeter to blind men than to others: and it is manifest that between sleeping and waking, when all the senses are bound and suspended, music is far sweeter than when one is fully waking.

Experiments in consort touching the imitation of sounds.

236. It is a thing strange in nature when it is attentively considered, how children, and some birds, learn to imitate speech. They take no mark at all of the motion of the mouth of him that speaketh, for birds are as well taught in the dark as by light. The sounds of speech are very curious and exquisite: so one would think it were a lesson hard to learn. It is true that it is done with time, and by little and little, and with many essays and profers: but all this dischargeth not the wonder. It would make a man think, though this which we shall say may seem exceeding strange, that there is some transmission of spirits; and that the spirits of the teacher put in motion, should work with the spirits of the learner a predisposition to offer to imitate; and so to perfect the imitation by degrees. But touching operations by transmissions of spirits, which is one of the highest secrets in nature, we shall speak in due place; chiefly when we come to inquire of imagination. But as for imitation, it is certain that there is in men and other creatures a pre-disposition to imitate. We see how ready apes and monkeys are to imitate all mo-

tions of man; and in the catching of dottrels, we see how the foolish bird playeth the ape in gestures: and no man, in effect, doth accompany with others, but he learneth, ere he is aware, some gesture, or voice or fashion of the other.

237. In imitation of sounds, that man should be the teacher is no part of the matter; for birds will learn one of another; and there is no reward by feeding, or the like, given them for the imitation; and besides, you shall have parrots that will not only imitate voices, but laughing, knocking, squeaking of a door upon the hinges, or of a cart-wheel; and, in effect, any other noise they hear.

238. No beast can imitate the speech of man but birds only; for the ape itself, that is so ready to imitate otherwise, attaineth not any degree of imitation of speech. It is true, that I have known a dog, that if one howled in his ear, he would fall a howling a great while. What should be the aptness of birds in comparison of beasts, to imitate the speech of man, may be further inquired. We see that beasts have those parts which they count the instruments of speech, as lips, teeth, *etc.* liker unto man than birds. As for the neck, by which the throat passeth, we see many beasts have it for the length as much as birds. What better gorge or artery birds have may be further inquired. The birds that are known to be speakers, are parrots, pies, jays, daws, and ravens. Of which parrots have an adunque bill, but the rest not.

239. But I conceive, that the aptness of birds is not so much in the conformity of the organs of speech, as in their attention. For speech must come by hearing and learning; and birds give more heed, and mark sounds more than beasts; because naturally they are more delighted with them, and practise them more, as appeareth in their singing. We see also that those that teach birds to sing, do keep them waking to increase their attention. We see also, that cock birds amongst singing-birds are ever the better singers; which may be because they are more lively and listen more.

240. Labour and intention to imitate voices, doth conduce much to imitation: and therefore we see that there be certain *pantomimi*, that will represent the voices of players of interludes so to the life, as if you see them not you would think they were those players themselves; and so the voices of other men that they hear.

241. There have been some that could counterfeit the distance of voices, which is a secondary object of hearing, in such sort, as when they stand fast by you, you would think the speech came from afar off, in a fearful manner. How this is done may be further inquired. But I see no great use of it but for imposture, in counterfeiting ghosts or spirits.

Experiments in consort touching the reflexion of sounds.

There be three kinds of reflexions of sounds; a reflexion concurrent, a reflexion iterant, which we call echo; and a super-reflexion, or an echo of an echo; whereof the first hath been handled in the title of magnitude of sounds: the latter two we will now speak of.

242. The reflexion of species visible by mirrors you may command; because passing in right lines they may be guided to any point: but the reflexion of sounds is hard to master; because the sound filling great spaces in arched lines, cannot be so guided: and therefore we see there hath not been practised any means to make artificial echos. And no echo already known returneth in a very narrow room.

243. The natural echos are made upon walls, woods, rocks, hills, and banks; as for waters, being near, they make a concurrent echo; but being farther off, as upon a large river, they make an iterant echo: for there is no difference between the concurrent echo and the iterant, but the quickness or slowness of the return. But there is no doubt but water doth help the dilation of echo; as well as it helpeth the dilation of original sounds.

244. It is certain, as hath been formerly touched, that if you speak through a trunk stopped at the farther end, you shall find a blast return upon your

mouth, but no sound at all. The cause is, for that the closeness which preserverh the original, is not able to preserve the reflected sound: besides that echos are seldom created but by loud sounds. And therefore there is less hope of artificial echos in air pent in a narrow concave. Nevertheless it hath been tried, that one leaning over a well of twenty five fathom deep, and speaking, though but softly, yet not so soft as a whisper, the water returned a good audible echo. It should be tried, whether speaking in caves, where there is no issue save where you speak, will not yield echos as wells do.

245. The echo cometh as the original sound doth, in a round orb of air: it were good to try the creating of the echo where the body repercussing maketh an angle: as against the return of a wall, *etc.* Also we see that in mirrors there is the like angle of incidence, from the object to the glass, and from the glass to the eye. And if you strike a ball side-long, not full upon the surface, the rebound will be as much the contrary way: whether there be any such resilience in echos, that is, whether a man shall hear better if he stand aside the body repercussing, than if he stand where he speaketh, or any where in a right line between, may be tried. Trial likewise should be made, by standing nearer the place of repercussing than he that speaketh; and again by standing farther off than he that speaketh; and so knowledge would be taken, whether echos, as well as original sounds, be not strongest near hand.

246. There be many places where you shall hear a number of echos one after another: and it is when there is variety of hills or woods, some nearer, some farther off: so that the return from the farther, being last created, will be likewise last heard.

247. As the voice goeth round, as well towards the back, as towards the front of him that speaketh; so likewise doth the echo: for you have many back echos to the place where you stand.

248. To make an echo that will report three, or four, or five words distinctly, it is requisite that the

body repercussing be a good distance off: for if it be near, and yet not so near as to make a concurrent echo, it choppeth with you upon the sudden. It is requisite likewise that the air be not much pent: for air at a great distance pent, worketh the same effect with air at large in a small distance. And therefore in the trial of speaking in the well, though the well was deep, the voice came back suddenly, and would bear the report but of two words.

249. For echos upon echos, there is a rare instance thereof in a place which I will now exactly describe. It is some three or four miles from Paris, near a town called Pont-Charenton; and some bird-bolt shot or more from the river of Sein. The room is a chapel or small church. The walls all standing, both at the sides and at the ends. Two rows of pillars, after the manner of isles of churches, also standing; the roof all open, not so much as any embowment near any of the walls left. There was against every pillar a stack of billets above a man's height; which the watermen that bring wood down the Sein in stacks, and not in boats, laid there, as it seemeth for their ease. Speaking at the one end, I did hear it return the voice thirteen several times; and I have heard of others, that it would return sixteen times: for I was there about three of the clock in the afternoon: and it is best, as all other echos are, in the evening. It is manifest that it is not echos from several places, but a tossing of the voice, as a ball, too and fro; like to reflexions in looking glasses, where if you place one glass before and another behind, you shall see the glass behind with the image, within the glass before; and again, the glass before in that; and divers such super-reflexions, till the *species speciei* at last die. For it is every return weaker and more shady. In like manner the voice in that chapel createth *speciem speciei*, and maketh succeeding super-reflexions; for it melteth by degrees, and every reflexion is weaker than the former: so that if you speak three words, it will, perhaps, some three times report you the whole three words; and then the two latter words for some

times; and then the last word alone for some times; still fading and growing weaker. And whereas in echos of one return, it is much to hear four or five words; in this echo of so many returns upon the matter, you hear above twenty words for three.

250. The like echo upon echo, but only with two reports, hath been observed to be, if you stand between a house and a hill, and lure towards the hill. For the house will give a back echo; one taking it from the other, and the latter the weaker.

251. There are certain letters that an echo will hardly express; as S for one, especially being principal in a word. I remember well, that when I went to the echo at Pont-Charenton, there was an old Parisian, that took it to be work of spirits, and of good spirits. For, said he, call *Satan*, and the echo will not deliver back the devil's name; but will say, *va t'en*; which is as much in French as *apage*, or void. And thereby I did hap to find, that an echo would not return S, being but a hissing and an interior sound.

252. Echos are some more sudden, and chop again as soon as the voice is delivered; as hath been partly said: others are more deliberate, that is, give more space between the voice and the echo; which is caused by the local nearness or distance: some will report a longer train of words, and some a shorter: some more loud, full as loud as the original, and sometimes more loud, and some weaker and fainter.

253. Where echos come from several parts at the same distance, they must needs make, as it were, a choir of echos, and so make the report greater, and even a continued echo; which you shall find in some hills that stand encompassed theatre-like.

254. It doth not yet appear that there is refraction in sounds, as well as in species visible. For I do not think, that if a sound should pass through divers mediums, as air, cloth, wood, it would deliver the sound in a different place from that unto which it is deferred; which is the proper effect of refraction. But majoration, which is also the work of refraction,

appeareth plainly in sounds, as hath been handled at full, but it is not by diversity of mediums.

Experiments in consort touching the consent and dissent between visibles and audibles.

We have *obiter*, for demonstration sake, used in divers instances the examples of the sight and things visible, to illustrate the nature of sounds: but we think good now to prosecute that comparison more fully.

Consent of visibles and audibles.

255. Both of them spread themselves in round, and fill a whole floor or orb unto certain limits; and are carried a great way: and do languish and lessen by degrees, according to the distance of the objects from the censories.

256. Both of them have the whole species in every small portion of the air, or medium, so as the species do pass through small crannies without confusion: as we see ordinarily in levels, as to the eye; and in crannies or chinks, as to the sound.

257. Both of them are of a sudden and easy generation and dilation; and likewise perish swiftly and suddenly; as if you remove the light, or touch the bodies that give the sound.

258. Both of them do receive and carry exquisite and accurate differences; as of colours, figures, motions, distances, in visibles; and of articulate voices, tones, songs, and quaverings, in audibles.

259. Both of them, in their virtue and working, do not appear to emit any corporal substance into their mediums, or the orb of their virtue; neither again to raise or stir any evident local motion in their mediums as they pass; but only to carry certain spiritual species; the perfect knowledge of the cause whereof, being hitherto scarcely attained, we shall search and handle in due place.

260. Both of them seem not to generate or produce any other effect in nature, but such as appertaineth to their proper objects and senses, and are otherwise barren.

261. But both of them in their own proper action do work three manifest effects. The first, in that the stronger species drowneth the lesser; as the light of the sun the light of a glow-worm; the report of an ordnance, the voice: The second, in that an object of surcharge or excess destroyeth the sense; as the light of the sun the eye; a violent sound near the ear the hearing: The third, in that both of them will be reverberate; as in mirrors and in echos.

262. Neither of them doth destroy or hinder the species of the other, although they encounter in the same medium; as light or colour hinder not sound, nor *è contra*.

263. Both of them affect the sense in living creatures, and yield objects of pleasure and dislike: yet nevertheless the objects of them do also, if it be well observed, affect and work upon dead things; namely, such as have some conformity with the organs of the two senses; as visibles work upon a looking-glass, which is like the pupil of the eye; and audibles upon the places of echo, which resemble in some sort the cavern and structure of the ear.

264. Both of them do diversly work, as they have their medium diversly disposed. So a trembling medium, as smoke, maketh the object seem to tremble; and a rising and falling medium, as winds, maketh the sounds to rise or fall.

265. To both, the medium, which is the most propitious and conducible, is air; for glass or water, *etc.* are not comparable.

266. In both of them, where the object is fine and accurate, it conduceth much to have the sense intentive and erect; insomuch as you contract your eye when you would see sharply; and erect your ear when you would hear attentively; which in beasts that have ears moveable is most manifest.

267. The beams of light, when they are multiplied and conglomerate, generate heat; which is a different action from the action of sight: and the multiplication and conglomeration of sounds doth generate an extreme rarefaction of the air; which is

an action materiate, differing from the action of sound; if it be true, which is anciently reported, that birds with great shouts, have fallen down.

Dissents of visibles and audibles.

268. The species of visibles seem to be emissions of beams from the objects seen, almost like odours, save that they are more incorporeal: but the species of audibles seem to participate more with local motion, like percussions, or impressions made upon the air. So that whereas all bodies do seem to work in two manners, either by the communication of their natures, or by the impressions and signatures of their motions; the diffusion of species visible seemeth to participate more of the former operation, and the species audible of the latter.

269. The species of audibles seem to be carried more manifestly through the air than the species of visibles: for I conceive that a contrary strong wind will not much hinder the sight of visibles, at it will do the hearing of sounds.

270. There is one difference above all others between visibles and audibles, that is the most remarkable, as that whereupon many smaller differences do depend: namely, that visibles, except lights, are carried in right lines, and audibles in arcuate lines. Hence it cometh to pass, that visibles do not intermingle and confound one another, as hath been said before; but sounds do. Hence it cometh, that the solidity of bodies doth not much hinder the sight, so that the bodies be clear, and the pores in a right line, as in glass, crystal, diamonds, water, *etc.* but a thin scarf or handkerchief, though they be bodies nothing so solid, hinder the sight: whereas, contrariwise, these porous bodies do not much hinder the hearing, but solid bodies do almost stop it, or at the least attenuate it. Hence also it cometh, that to the reflexion of visibles small glasses suffice; but to the reverberation of audibles are required greater spaces, as hath likewise been said before.

271. Visibles are seen farther off than sounds are

heard; allowing nevertheless the rate of their bigness; for otherwise a great sound will be heard farther off than a small body seen.

272. Visibles require, generally, some distance between the object and the eye, to be better seen; whereas in audibles, the nearer the approach of the sound is to the sense, the better. But in this there may be a double error. The one because to seeing there is required light; and any thing that toucheth the pupil of the eye all over excludeth the light. For I have heard of a person very credible, who himself was cured of a cataract in one of his eyes, that while the silver needle did work upon the sight of his eye, to remove the film of the cataract, he never saw any thing more clear or perfect than that white needle: which, no doubt, was, because the needle was lesser than the pupil of the eye, and so took not the light from it. The other error may be, for that the object of sight doth strike upon the pupil of the eye directly without any interception; whereas the cave of the ear doth hold off the sound a little from the organ: and so nevertheless there is some distance required in both.

273. Visibles are swiftlier carried to the sense than audibles; as appeareth in thunder and lightning, flame and report of a piece, motion of the air in hewing of wood. All which have been set down heretofore, but are proper for this title.

274. I conceive also, that the species of audibles do hang longer in the air than those of visibles: for although even those of visibles do hang some time, as we see in rings turned, that shew like spheres; in lute-strings fillipped; a fire-brand carried along, which leaveth a train of light behind it; and in the twilight; and the like: yet I conceive that sounds stay longer, because they are carried up and down with the wind; and because of the distance of the time in ordnance discharged, and heard twenty miles off.

275. In visibles there are not found objects so odious and ingrate to the sense as in audibles. For foul

sights do rather displease, in that they excite the memory of foul things, than in the immediate objects. And therefore in pictures, those foul sights do not much offend; but in audibles, the grating of a saw, when it is sharpened, doth offend so much, as it setteth the teeth on edge. And any of the harsh discords in music the ear doth straightways refuse.

276. In visibles, after great light, if you come suddenly into the dark, or contrariwise, out of the dark into a glaring light, the eye is dazzled for a time, and the sight confused; but whether any such effect be after great sounds, or after a deep silence, may be better inquired. It is an old tradition, that those that dwell near the cataracts of Nilus, are struck deaf: but we find no such effect in cannoneers, nor millers, nor those that dwell upon bridges.

277. It seemeth that the impression of colour is so weak, as it worketh not but by a cone of direct beams, or right lines, whereof the basis is in the object, and the vertical point in the eye; so as there is a corradiation and conjunction of beams; and those beams so sent forth, yet are not of any force to beget the like borrowed or second beams, except it be by reflexion, whereof we speak not. For the beams pass and give little tincture to that air which is adjacent; which if they did, we should see colours out of a right line. But as this is in colours, so otherwise it is in the body of light. For when there is a skreen between the candle and the eye, yet the light passeth to the paper whereon one writeth; so that the light is seen where the body of the flame is not seen, and where any colour, if it were placed where the body of the flame is, would not be seen. I judge that sound is of this latter nature; for when two are placed on both sides of a wall, and the voice is heard, I judge it is not only the original sound which passeth in an arched line; but the sound which passeth above the wall in a right line, begetteth the like motion round about it as the first did, though more weak.

Experiments in consort touching the sympathy or antipathy of sounds one with another.

278. All concords and discords of music are, no doubt, sympathies and antipathies of sounds. And so, likewise, in that music which we call broken music or consort music, some consorts of instruments are sweeter than others, a thing not sufficiently yet observed: as the Irish harp and base viol agree well: the recorder and stringed music agree well: organs and the voice agree well, *etc.* But the virginals and the lute; or the Welsh harp and Irish harp; or the voice and pipes alone, agree not so well; but for the melioration of music, there is yet much left, in this point of exquisite consorts, to try and inquire.

279. There is a common observation, that if a lute or viol be laid upon the back, with a small straw upon one of the strings; and another lute or viol be laid by it; and in the other lute or viol the unison to that string be struck, it will make the string move; which will appear both to the eye and by the straw's falling off. The like will be, if the diapason or eighth to that string be struck, either in the same lute or viol, or in others lying by; but in none of these there is any report of sound that can be discerned, but only motion.

280. It was devised, that a viol should have a lay of wire-strings below, as close to the belly as a lute; and then the strings of guts mounted upon a bridge as in ordinary viols; to the end that by this means the upper strings struck, should make the lower resound by sympathy, and so make the music the better; which if it be to purpose, then sympathy worketh as well by report of sound as by motion. But this device I conceive to be of no use, because the upper strings, which are stopped in great variety, cannot maintain a diapason or unison with the lower, which are never stopped. But if it should be of use at all, it must be in instruments which have no stops, as virginals and harps; wherein trial may be made of two rows of strings, distant the one from the other.

281. The experiment of sympathy may be transferred, perhaps, from instruments of strings to other instruments of sound. As to try, if there were in one steeple two bells of unison, whether the striking of the one would move the other, more than if it were another accord: and so in pipes, if they be of equal bore and sound, whether a little straw or feather would move in the one pipe, when the other is blown at an unison.

282. It seemeth, both in ear and eye, the instrument of sense hath a sympathy or similitude with that which giveth the reflexion, as hath been touched before: for as the sight of the eye is like a crystal or glass, or water; so is the ear a sinuous cave, with a hard bone to stop and reverberate the sound: which is like to the places that report echos.

Experiments in consort touching the hindering or helping of the hearing.

283. When a man yawneth, he cannot hear so well. The cause is, for that the membrane of the ear is extended; and so rather casteth off the sound than draweth it to.

284. We hear better when we hold our breath than contrary: insomuch as in all listening to attain a sound afar off men hold their breath. The cause is, for that in all expiration the motion is outwards; and therefore rather driveth away the voice than draweth it: and besides we see, that in all labour to do things with any strength, we hold the breath; and listening after any sound that is heard with difficulty, is a kind of labour.

285. Let it be tried, for the help of the hearing, and I conceive it likely to succeed, to make an instrument like a tunnel; the narrow part whereof may be of the bigness of the hole of the ear; and the broader end much larger, like a bell at the skirts; and the length half a foot or more. And let the narrow end of it be set close to the ear: and mark whether any sound, abroad in the open air, will not be heard distinctly from farther distance, than without

that instrument; being, as it were, an ear-spectacle. And I have heard there is in Spain an instrument in use to be set to the ear, that helpeth somewhat those that are thick of hearing.

286. If the mouth be shut close, nevertheless there is yielded by the roof of the mouth a murmur; such as is used by dumb men. But if the nostrils be likewise stopped, no such murmur can be made: except it be in the bottom of the palate towards the throat. Whereby it appeareth manifestly, that a sound in the mouth, except such as aforesaid, if the mouth be stopped, passeth from the palate through the nostrils.

Experiments in consort touching the spiritual and fine nature of sounds.

287. The repercussion of sounds, which we call echo, is a great argument of the spiritual essence of sounds. For if it were corporeal, the repercussion should be created in the same manner, and by like instruments, with the original sound: but we see what a number of exquisite instruments must concur in speaking of words, whereof there is no such matter in the returning of them, but only a plain stop and repercussion.

288. The exquisite differences of articulate sounds, carried along in the air, shew that they cannot be signatures or impressions in the air, as hath been well refuted by the ancients. For it is true, that seals make excellent impressions; and so it may be thought of sounds in their first generation: but then the dilation and continuance of them without any new sealing, shew apparently they cannot be impressions.

289. All sounds are suddenly made, and do suddenly perish: but neither that, nor the exquisite differences of them, is matter of so great admiration: for the quaverings and warblings in lutes and pipes are as swift; and the tongue, which is no very fine instrument, doth in speech make no fewer motions than there be letters in all the words which are uttered. But that sounds should not only be so speedily generated, but carried so far every way in such a moment-

ary time, deserveth more admiration. As for example, if a man stand in the middle of a field and speak aloud, he shall be heard a furlong in a round; and that shall be in articulate sounds; and those shall be entire in every little portion of the air; and this shall be done in the space of less than a minute.

290. The sudden generation and perishing of sounds, must be one of these two ways. Either that the air suffereth some force by sound, and then restoreth itself as water doth; which being divided, maketh many circles, till it restore itself to the natural consistence: or otherwise, that the air doth willingly imbibe the sound as grateful, but cannot maintain it; for that the air hath, as it should seem, a secret and hidden appetite of receiving the sound at the first; but then other gross and more materiate qualities of the air straightways suffocate it; like unto flame, which is generated with alacrity, but straight quenched by the enmity of the air or other ambient bodies.

There be these differences, in general, by which sounds are divided: 1. Musical, immusical. 2. Treble, base. 3. Flat, sharp. 4. Soft, loud. 5. Exterior, interior. 6. Clean, harsh or purling. 7. Articulate, inarticulate.

We have laboured, as may appear, in this inquisition of sounds diligently; both because sound is one of the most hidden portions of nature, as we said in the beginning, and because it is a virtue which may be called incorporeal and immateriate; whereof there be in nature but few. Besides, we were willing, now in these our first centuries, to make a pattern or precedent of an exact inquisition; and we shall do the like hereafter in some other subjects which require it. For we desire that men should learn and perceive, how severe a thing the true inquisition of nature is; and should accustom themselves by the light of particulars to enlarge their minds to the amplitude of the world, and not reduce the world to the narrowness of their minds.

Experiment solitary touching the orient colours in dissolution of metals.

291. METALS give orient and fine colours in dissolutions; as gold giveth an excellent yellow; quicksilver an excellent green; tin giveth an excellent azure: likewise in their putrefactions or rusts; as vermilion, verdigrease, bise, cirrus, *etc.* and likewise in their vitrifications. The cause is, for that by their strength of body they are able to endure the fire or strong waters, and to be put into an equal posture; and again to retain part of their principal spirit; which two things, equal posture and quick spirits, are required chiefly to make colours lightsome.

Experiment solitary touching prolongation of life.

292. IT conduceth unto long life, and to the more placid motion of the spirits, which thereby do less prey and consume the juice of the body, either that mens actions be free and voluntary, that nothing be done *invita Minerva*, but *secundum genium;* or on the other side, that the actions of men be full of regulation and commands within themselves: for then the victory and performing of the command giveth a good disposition to the spirits; especially if there be a proceeding from degree to degree; for then the sense of the victory is the greater. An example of the former of these is a country life; and of the latter in monks and philosophers, and such as do continually enjoy themselves.

Experiment solitary touching appetite of union in bodies.

293. IT is certain that in all bodies there is an appetite of union and evitation of solution of continuity: and of this appetite there be many degrees; but the most remarkable and fit to be distinguished are three. The first in liquors; the second in hard bodies; and the third in bodies cleaving or tenacious. In liquors this appetite is weak: we see in liquors, the threading of them in stillicides, as hath been said; the falling of them in round drops, which is the form of union; and the staying of them for a little time in bubbles

and froth. In the second degree or kind, this appetite is strong; as in iron, in stone, in wood, *etc.* In the third, this appetite is in a medium between the other two: for such bodies do partly follow the touch of another body, and partly stick and continue to themselves; and therefore they rope, and draw themselves in threads; as we see in pitch, glue, birdlime, *etc.* But note, that all solid bodies are cleaving more or less: and that they love better the touch of somewhat that is tangible, than of air. For water in small quantity cleaveth to any thing that is solid; and so would metal too, if the weight drew it not off. And therefore gold foliate, or any metal foliate, cleaveth: but those bodies which are noted to be clammy and cleaving, are such as have a more indifferent appetite at once to follow another body, and to hold to themselves. And therefore they are commonly bodies ill mixed; and which take more pleasure in a foreign body, than in preserving their own consistence; and which have little predominance in drought or moisture.

Experiment solitary touching the like operations of heat and time.

294. Time and heat are fellows in many effects. Heat drieth bodies that do easily expire; as parchment, leaves, roots, clay, *etc.* And so doth time or age arefy; as in the same bodies, *etc.* Heat dissolveth and melteth bodies that keep in their spirits; as in divers liquefactions: and so doth time in some bodies of a softer consistence, as is manifest in honey, which by age waxeth more liquid, and the like in sugar; and so in old oil, which is ever more clear and more hot in medicinable use. Heat causeth the spirits to search some issue out of the body; as in the volatility of metals; and so doth time; as in the rust of metals. But generally heat doth that in a small time, which age doth in long.

Experiment solitary touching the differing operations of fire and time.

295. Some things which pass the fire are softest at first, and by time grow hard, as the crumb of bread. Some are harder when they come from the fire, and afterwards give again, and grow soft, as the crust of bread, biskit, sweet-meats, salt, *etc.* The cause is, for that in those things which wax hard with time, the work of the fire is a kind of melting; and in those that wax soft with time, contrariwise, the work of the fire is a kind of baking; and whatsoever the fire baketh, time doth in some degree dissolve.

Experiment solitary, touching motions by imitation.

296. Motions pass from one man to another, not so much by exciting imagination, as by imitation; especially if there be an aptness or inclination before. Therefore gaping, or yawning, and stretching do pass from man to man; for that that causeth gaping and stretching is, when the spirits are a little heavy by any vapour, or the like. For then they strive, as it were, to wring out and expel that which loadeth them. So men drowsy, and desirous to sleep, or before the fit of an ague, do use to yawn and stretch; and do likewise yield a voice or sound, which is an interjection of expulsion: so that if another be apt and prepared to do the like, he followeth by the sight of another. So the laughing of another maketh to laugh.

Experiment solitary touching infectious diseases.

297. There be some known diseases that are infectious; and others that are not. Those that are infectious are, first, such as are chiefly in the spirits, and not so much in the humours; and therefore pass easily from body to body; such are pestilences, lepitudes, and such like. Secondly, such as taint the breath, which we see passeth manifestly from man to man; and not invisibly, as the effects of the spirits do; such are consumptions of the lungs, *etc.* Thirdly, such as come forth to the skin, and therefore taint the air or the body adjacent; especially if they consist

in an unctuous substance not apt to dissipate; such are scabs and leprosy. Fourthly, such as are merely in the humours, and not in the spirits, breath, or exhalations: and therefore they never infect but by touch only; and such a touch also as cometh within the *epidermis;* as the venom of the French pox, and the biting of a mad dog.

Experiment solitary touching the incorporation of powders and liquors.

298. Most powders grow more close and coherent by mixture of water, than by mixture of oil, though oil be the thicker body; as meal, *etc.* The reason is the congruity of bodies; which if it be more, maketh a perfecter imbibition and incorporation; which in most powders is more between them and water, than between them and oil: but painters colours ground, and ashes, do better incorporate with oil.

Experiment solitary touching exercise of the body.

299. Much motion and exercise is good for some bodies; and sitting and less motion for others. If the body be hot and void of superfluous moistures, too much motion hurteth: and it is an error in physicians, to call too much upon exercise. Likewise men ought to beware, that they use not exercise and a spare diet both: but if much exercise, then a plentiful diet; and if sparing diet, then little exercise. The benefits that come of exercise are, first, that it sendeth nourishment into the parts more forcibly. Secondly, that it helpeth to excern by sweat, and so maketh the parts assimilate the more perfectly. Thirdly, that it maketh the substance of the body more solid and compact; and so less apt to be consumed and depredated by the spirits. The evils that come of exercise are, first, that it maketh the spirits more hot and predatory. Secondly, that it doth absorb likewise, and attenuate too much the moisture of the body. Thirdly, that it maketh too great concussion, especially if it be violent, of the inward parts, which delight more in rest. But generally exercise, if it be much, is no friend to prolonga-

tion of life; which is one cause why women live longer than men, because they stir less.

Experiments solitary touching meats that induce satiety.

300. Some food we may use long, and much, without glutting; as bread, flesh that is not fat or rank, *etc.* Some other, though pleasant, glutteth sooner; as sweet-meats, fat meats, *etc.* The cause is, for that appetite consisteth in the emptiness of the mouth of the stomach; or possessing it with somewhat that is astringent; and therefore cold and dry. But things that are sweet and fat are more filling; and do swing and hang more about the mouth of the stomach; and go not down so speedily: and again turn sooner to choler, which is hot and ever abateth the appetite. We see also that another cause of satiety is an over-custom; and of appetite is novelty; and therefore meats, if the same be continually taken, induce loathing. To give the reason of the distaste of satiety, and the pleasure of novelty; and to distinguish not only in meats and drinks, but also in motions, loves, company, delights, studies, what they be that custom maketh more grateful, and what more tedious, were a large field. But for meats the cause is attraction, which is quicker, and more excited towards that which is new, than towards that whereof there remaineth a relish by former use. And, generally, it is a rule, that whatsoever is somewhat ingrate at first, is made grateful by custom; but whatsoever is too pleasing at first, groweth quickly to satiate.

NATURAL HISTORY.

CENTURY IV.

Experiments in consort touching the clarification of liquors, and the accelerating thereof.

ACCELERATION of time, in works of nature, may well be esteemed *inter magnalia naturæ*. And even in divine miracles, accelerating of the time is next to the creating of the matter. We will now therefore proceed to the inquiry of it: and for acceleration of germination, we will refer it over unto the place where we shall handle the subject of plants generally; and will now begin with other accelerations.

301. LIQUORS are, many of them, at the first thick and troubled; as muste, wort, juices of fruits, or herbs expressed, *etc.* and by time they settle and clarify. But to make them clear before the time is a great work; for it is a spur to nature, and putteth her out of her pace: and, besides, it is of good use for making drinks and sauces potable and serviceable speedily. But to know the means of accelerating clarification, we must first know the causes of clarification. The first cause is, by the separation of the grosser parts of the liquor from the finer. The second, by the equal distribution of the spirits of the liquor with the tangible parts: for that ever representeth bodies clear and untroubled. The third, by the refining the spirit itself, which thereby giveth to the liquor more splendor and more lustre.

302. FIRST, for separation, it is wrought by weight, as in the ordinary residence or settlement of liquors; by heat, by motion, by precipitation, or sublimation, that is, a calling of the several parts either up or down, which is a kind of attraction; by adhesion, as when a

body more viscous is mingled and agitated with the liquor, which viscous body, afterwards severed, draweth with it the grosser parts of the liquor; and lastly, by percolation or passage.

303. Secondly, for the even distribution of the spirits, it is wrought by gentle heat; and by agitation or motion, for of time we speak not, because it is that we would anticipate and represent; and it is wrought also by mixture of some other body which hath a virtue to open the liquor, and to make the spirits the better pass through.

304. Thirdly, for the refining of the spirit, it is wrought likewise by heat; by motion; and by mixture of some body which hath virtue to attenuate. So therefore, having shewn the causes, for the accelerating of clarification in general, and the inducing of it, take these instances and trials.

305. It is in common practice to draw wine or beer from the lees, which we call racking, whereby it will clarify much the sooner: for the lees, though they keep the drink in heart, and make it lasting; yet withal they cast up some spissitude: and this instance is to be referred to separation.

306. On the other side it were good to try, what the adding to the liquor more lees than his own will work; for though the lees do make the liquor turbid, yet they refine the spirits. Take therefore a vessel of new beer, and take another vessel of new beer, and rack the one vessel from the lees, and pour the lees of the racked vessel into the unracked vessel, and see the effect: this instance is referred to the refining of the spirits.

307. Take new beer, and put in some quantity of stale beer into it, and see whether it will not accelerate the clarification, by opening the body of the beer, and cutting the grosser parts, whereby they may fall down into lees. And this instance again is referred to separation.

308. The longer malt or herbs, or the like, are infused in liquor, the more thick and troubled the liquor is; but the longer they be decocted in the

liquor, the clearer it is. The reason is plain, because in infusion, the longer it is, the greater is the part of the gross body that goeth into the liquor: but in decoction, though more goeth forth, yet it either purgeth at the top, or settleth at the bottom. And therefore the most exact way to clarify is, first, to infuse, and then to take off the liquor and decoct it; as they do in beer, which hath malt first infused in the liquor, and is afterwards boiled with the hop. This also is referred to separation.

309. Take hot embers, and put them about a bottle filled with new beer, almost to the very neck; let the bottle be well stopped, lest it fly out: and continue it, renewing the embers every day, by the space of ten days; and then compare it with another bottle of the same beer set by. Take also lime both quenched and unquenched, and set the bottles in them *ut supra*. This instance is referred both to the even distribution, and also to the refining of the spirits by heat.

310. Take bottles and swing them, or carry them in a wheel-barrow upon rough ground twice in a day, but then you may not fill the bottles full, but leave some air; for if the liquor come close to the stopple, it cannot play nor flower: and when you have shaken them well either way, pour the drink into another bottle stopped close after the usual manner; for if it stay with much air in it, the drink will pall; neither will it settle so perfectly in all the parts. Let it stand some twenty-four hours: then take it, and put it again into a bottle with air, *ut supra:* and thence into a bottle stopped, *ut supra:* and so repeat the same operation for seven days. Note, that in the emptying of one bottle into another, you must do it swiftly lest the drink pall. It were good also to try it in a bottle with a little air below the neck, without emptying. This instance is referred to the even distribution and refining of the spirits by motion.

311. As for percolation inward and outward, which belongeth to separation, trial would be made of clarifying by adhesion, with milk put into new beer, and stirred with it: for it may be that the grosser

part of the beer will cleave to the milk: the doubt is, whether the milk will sever well again; which is soon tried. And it is usual in clarifying hippocras to put in milk; which after severeth and carrieth with it the grosser parts of the hippocras, as hath been said elsewhere. Also for the better clarification by percolation, when they tun new beer, they use to let it pass through a strainer; and it is like the finer the strainer is, the clearer it will be.

Experiments in consort touching maturation, and the accelerating thereof. And first touching the maturation and quickening of drinks. And next, touching the maturation of fruits.

The accelerating of maturation we will now inquire of. And of maturation itself. It is of three natures. The maturation of fruits: the maturation of drinks: and the maturation of impostumes and ulcers. This last we refer to another place, where we shall handle experiments medicinal. There be also other maturations, as of metals, &c. whereof we will speak as occasion serveth. But we will begin with that of drinks, because it hath such affinity with the clarification of liquors.

312. For the maturation of drinks, it is wrought by the congregation of the spirits together, whereby they digest more perfectly the grosser parts: and it is effected partly by the same means that clarification is, whereof we spake before; but then note, that an extreme clarification doth spread the spirits so smooth, as they become dull, and the drink dead, which ought to have a little flowering. And therefore all your clear amber drink is flat.

313. We see the degrees of maturation of drinks; in muste, in wine, as it is drunk, and in vinegar. Whereof muste hath not the spirits well congregated; wine hath them well united, so as they make the parts somewhat more oily; vinegar hath them congregated, but more jejune, and in smaller quantity, the greatest and finest spirit and part being exhaled: for we see vinegar is made by setting the vessel of

wine against the hot sun; and therefore vinegar will not burn; for that much of the finer parts is exhaled.

314. The refreshing and quickening of drink palled or dead, is by enforcing the motion of the spirit: so we see that open weather relaxeth the spirit, and maketh it more lively in motion. We see also bottling of beer or ale, while it is new and full of spirit, so that it spirteth when the stopple is taken forth, maketh the drink more quick and windy. A pan of coals in the cellar doth likewise good, and maketh the drink work again. New drink put to drink that is dead provoketh it to work again: nay, which is more, as some affirm, a brewing of new beer set by old beer, maketh it work again. It were good also to enforce the spirits by some mixtures, that may excite and quicken them; as by putting into the bottles, nitre, chalk, lime, *&c.* We see cream is matured, and made to rise more speedily by putting in cold water; which, as it seemeth, getteth down the whey.

315. It is tried, that the burying of bottles of drink well stopped, either in dry earth a good depth; or in the bottom of a well within water; and best of all, the hanging of them in a deep well somewhat above the water for some fortnight's space, is an excellent means of making drink fresh and quick; for the cold doth not cause any exhaling of the spirits at all, as heat doth, though it rarifieth the rest that remain: but cold maketh the spirits vigorous, and irritateth them, whereby they incorporate the parts of the liquor perfectly.

316. As for the maturation of fruits; it is wrought by the calling forth of the spirits of the body outward, and so spreading them more smoothly: and likewise by digesting in some degree the grosser parts: and this is effected by heat, motion, attraction; and by a rudiment of putrefaction: for the inception of putrefaction hath in it a maturation.

317. There were taken apples, and laid in straw; in hay; in flour; in chalk; in lime; covered over with onions; covered over with crabs; closed up in wax; shut in a box, *etc.* There was also an apple

hanged up in smoke; of all which the experiment sorted in this manner.

318. After a month's space, the apple inclosed in wax was as green and fresh as at the first putting in, and the kernels continued white. The cause is, for that all exclusion of open air, which is ever predatory, maintaineth the body in its first freshness and moisture: but the inconvenience is, that it tasteth a little of the wax; which, I suppose, in a pomegranate, or some such thick-coated fruit, it would not do.

319. The apple hanged in the smoke, turned like an old mellow apple wrinkled, dry, soft, sweet, yellow within. The cause is, for that such a degree of heat, which doth neither melt nor scorch, for we see that in a great heat, a roast apple softeneth and melteth; and pig's feet, made of quarters of wardens, scorch and have a skin of cole, doth mellow, and not adure: the smoke also maketh the apple, as it were, sprinkled with soot, which helpeth to mature. We see that in drying of pears and prunes in the oven, and removing of them often as they begin to sweat, there is a like operation; but that is with a far more intense degree of heat.

320. The apples covered in the lime and ashes were well matured; as appeared both in their yellowness and sweetness. The cause is, for that that degree of heat which is in lime and ashes, being a smothering heat, is of all the rest most proper, for it doth neither liquefy nor arefy; and that is true maturation. Note, that the taste of those apples was good; and therefore it is the experiment fitted for use.

321. The apples covered with crabs and onions were likewise well matured. The cause is, not any heat; but for that the crabs and the onions draw forth the spirits of the apple, and spread them equally throughout the body; which taketh away hardness. So we see one apple ripeneth against another. And therefore in making of cyder they turn the apples first upon a heap. So one cluster of grapes that toucheth another whilst it groweth, ripeneth faster; *botrus contra botrum citius maturescit.*

322. The apples in the hay and straw ripened apparently, though not so much as the other; but the apple in the straw more. The cause is, for that the hay and straw have a very low degree of heat, but yet close and smothering, and which drieth not.

323. The apple in the close box was ripened also: the cause is, for that all air kept close hath a degree of warmth: as we see in wool, fur, plush, *etc.* Note, that all these were compared with another apple of the same kind, that lay of itself: and in comparison of that were more sweet and more yellow, and so appeared to be more ripe.

324. Take an apple, or pear, or other like fruit, and roll it upon a table hard: we see in common experience, that the rolling doth soften and sweeten the fruit presently; which is nothing but the smooth distribution of the spirits into the parts: for the unequal distribution of the spirits maketh the harshness: but this hard rolling is between concoction, and a simple maturation; therefore, if you should roll them but gently, perhaps twice a day; and continue it some seven days, it is like they would mature more finely, and like unto the natural maturation.

325. Take an apple, and cut out a piece of the top, and cover it, to see whether that solution of continuity will not hasten a maturation: we see that where a wasp, or a fly, or a worm hath bitten in a grape, or any fruit, it will sweeten hastily.

326. Take an apple *etc.* and prick it with a pin full of holes, not deep, and smear it a little with sack or cinnamon water, or spirit of wine, every day for ten days, to see if the virtual heat of the wine or strong waters will not mature it.

In these trials also, as was used in the first, set another of the same fruits by to compare them; and try them by their yellowness and by their sweetness.

Experiment solitary touching the making of gold.

The world hath been much abused by the opinion of making of gold: the work itself I judge to be possible; but the means, hitherto propounded, to effect it, are, in the practice, full of error and im-

posture; and in the theory, full of unsound imaginations. For to say, that nature hath an intention to make all metals gold; and that, if she were delivered from impediments, she would perform her own work; and that if the crudities, impurities, and leprosities of metals were cured, they would become gold; and that a little quantity of the medicine, in the work of projection, will turn a sea of the baser metal into gold by multiplying: all these are but dreams; and so are many other grounds of alchemy. And to help the matter, the alchemists call in likewise many vanities out of astrology, natural magic, superstitious interpretations of scriptures, auricular traditions, feigned testimonies of ancient authors, and the like. It is true, on the other side, they have brought to light not a few profitable experiments, and thereby made the world some amends. But we, when we shall come to handle the version and transmutation of bodies, and the experiments concerning metals and minerals, will lay open the true ways and passages of nature, which may lead to this great effect. And we commend the wit of the Chineses, who despair of making of gold, but are mad upon the making of silver; for certain it is, that it is more difficult to make gold, which is the most ponderous and materiate amongst metals, of other metals less ponderous and less materiate; than *via versa*, to make silver of lead or quicksilver; both which are more ponderous than silver; so that they need rather a farther degree of fixation, than any condensation. In the mean time, by occasion of handling the axioms touching maturation, we will direct a trial touching the maturing of metals, and thereby turning some of them into gold: for we conceive indeed, that a perfect good concoction, or digestion, or maturation of some metals, will produce gold. And here we call to mind, that we knew a Dutchman, that had wrought himself into the belief of a great person, by undertaking that he could make gold: whose discourse was, that gold might be made; but that the alchemists over-fired the work: for, he said, the making of gold did re-

quire a very temperate heat, as being in nature a subterrany work, where little heat cometh; but yet more to the making of gold than of any other metal; and therefore that he would do it with a great lamp that should carry a temperate and equal heat: and that it was the work of many months. The device of the lamp was folly; but the over-firing now used, and the equal heat to be required, and the making it a work of some good time, are no ill discourses.

We resort therefore to our axioms of maturation, in effect touched before. The first is, that there be used a temperate heat; for they are ever temperate heats that digest and mature: wherein we mean temperate according to the nature of the subject; for that may be temperate to fruits and liquors, which will not work at all upon metals. The second is, that the spirits of the metal be quickened, and the tangible parts opened: for without those two operations, the spirit of the metal wrought upon will not be able to digest the parts. The third is, that the spirits do spread themselves even, and move not subsultorily; for that will make the parts close and pliant. And this requireth a heat that doth not rise and fall, but continue as equal as may be. The fourth is, that no part of the spirit be emitted, but detained: for if there be emission of spirit the body of the metal will be hard and churlish. And this will be performed, partly by the temper of the fire; and partly by the closeness of the vessel. The fifth is, that there be choice made of the likeliest and best prepared metal for the version: for that will facilitate the work. The sixth is, that you give time enough for the work: not to prolong hopes, as the alchemists do, but indeed to give nature a convenient space to work in. These principles are most certain and true; we will now derive a direction of trial out of them, which may, perhaps, by farther meditation be improved.

327. Let there be a small furnace made of a temperate heat; let the heat be such as may keep the metal perpetually molten, and no more; for that above all importeth to the work. For the material, take

silver, which is the metal that in nature symbolizeth most with gold; put in also with the silver, a tenth part of quicksilver, and a twelfth part of nitre, by weight; both these to quicken and open the body of the metal: and so let the work be continued by the space of six months at the least. I wish also, that there be at sometimes an injection of some oiled substance; such as they use in the recovering of gold, which by vexing with separations hath been made churlish: and this is to lay the parts more close and smooth, which is the main work. For gold, as we see, is the closest, and therefore the heaviest of metals; and is likewise the most flexible and tensible. Note, that to think to make gold of quicksilver, because it is the heaviest, is a thing not to be hoped; for quicksilver will not indure the manage of the fire. Next to silver, I think copper were fittest to be the material.

Experiment solitary touching the nature of gold.

328. Gold hath these natures; greatness of weight; closeness of parts; fixation; pliantness, or softness; immunity from rust; colour or tincture of yellow. Therefore the sure way, though most about, to make gold, is to know the causes of the several natures before rehearsed, and the axioms concerning the same. For if a man can make a metal that hath all these properties, let men dispute whether it be gold or no.

Experiments in consort touching the inducing and accelerating of putrefaction.

The inducing and accelerating of putrefaction, is a subject of a very universal inquiry; for corruption is a reciprocal to generation: and they two are as nature's two terms or boundaries; and the guides to life and death. Putrefaction is the work of the spirits of bodies, which ever are unquiet to get forth and congregate with the air, and to enjoy the sun-beams. The getting forth, or spreading of the spirits, which is a degree of getting forth, hath five differing operations. If the spirits be detained within the body, and move more violently, there followeth colliquation,

as in metals, *etc.* If more mildly, there followeth digestion, or maturation; as in drinks and fruits. If the spirits be not merely detained, but protrude a little, and that motion be confused and inordinate, there followeth putrefaction; which ever dissolveth the consistence of the body into much inequality; as in flesh, rotten fruits, shining wood, *etc.* and also in the rust of metals. But if that motion be in a certain order, there followeth vivification and figuration; as both in living creatures bred of putrefaction, and in living creatures perfect. But if the spirits issue out of the body, there followeth desiccation, induration, consumption, *etc.* as in brick, evaporation of bodies liquid, *etc.*

329. The means to induce and accelerate putrefaction, are, first, by adding some crude or watery moisture; as in wetting of any flesh, fruit, wood, with water, *etc.* for contrariwise unctuous and oily substances preserve.

330. The second is by invitation or excitation; as when a rotten apple lieth close to another apple that is sound: or when dung, which is a substance already putrified, is added to other bodies. And this is also notably seen in church-yards where they bury much, where the earth will consume the corpse in far shorter time than other earth will.

331. The third is by closeness and stopping, which detaineth the spirits in prison more than they would; and thereby irritateth them to seek issue; as in corn and cloths which wax musty; and therefore open air, which they call *aër perflabilis*, doth preserve: and this doth appear more evidently in agues, which come, most of them, of obstructions and penning the humours which thereupon putrify.

332. The fourth is by solution of continuity; as we see an apple will rot sooner if it be cut or pierced; and so will wood, *etc.* And so the flesh of creatures alive, where they have received any wound.

333. The fifth is either by the exhaling or by the driving back of the principal spirits which preserve the consistence of the body; so that when their govern-

ment is dissolved, every part returneth to his nature or homogeny. And this appeareth in urine and blood when they cool, and thereby break: it appeareth also in the gangrene, or mortification of flesh, either by opiates or by intense colds. I conceive also the same effect is in pestilences; for that the malignity of the infecting vapour danceth the principal spirits, and maketh them fly and leave their regiment; and then the humours, flesh, and secondary spirits, do dissolve and break, as in an anarchy.

334. The sixth is when a foreign spirit, stronger and more eager than the spirit of the body, entreth the body; as in the stinging of serpents. And this is the cause, generally, that upon all poisons followeth swelling: and we see swelling followeth also when the spirits of the body itself congregate too much, as upon blows and bruises; or when they are pent in too much, as in swelling upon cold. And we see also, that the spirits coming of putrefaction of humours in agues, *etc.* which may be counted as foreign spirits, though they be bred within the body, do extinguish and suffocate the natural spirits and heat.

335. The seventh is by such a weak degree of heat, as setteth the spirits in a little motion, but is not able either to digest the parts, or to issue the spirits; as is seen in flesh kept in a room, that is not cool: whereas in a cool and wet larder it will keep longer. And we see that vivification, whereof putrefaction is the bastard brother, is effected by such soft heats; as the hatching of eggs, the heat of the womb, *etc.*

336. The eighth is by the releasing of the spirits, which before were close kept by the solidness of their coverture, and thereby their appetite of issuing checked; as in the artificial rusts induced by strong waters in iron, lead, *etc.* and therefore wetting hasteneth rust or putrefaction of any thing, because it softeneth the crust for the spirits to come forth.

337. The ninth is by the interchange of heat and cold, or wet and dry; as we see in the mouldering of earth in frosts and sun; and in the more hasty rotting of wood, that is sometimes wet, sometimes dry.

338. The tenth is by time, and the work and procedure of the spirits themselves, which cannot keep their station; especially if they be left to themselves, and there be not agitation or local motion. As we see in corn not stirred; and mens bodies not exercised.

339. All moulds are inceptions of putrefaction; as the moulds of pies and flesh; the moulds of oranges and lemons, which moulds afterwards turn into worms, or more odious putrefactions: and therefore, commonly, prove to be of ill odour. And if the body be liquid, and not apt to putrify totally, it will cast up a mother in the top, as the mothers of distilled waters.

340. Moss is a kind of mould of the earth and trees. But it may be better sorted as a rudiment of germination; to which we refer it.

Experiments in consort touching prohibiting and preventing putrefaction.

It is an inquiry of excellent use, to inquire of the means of preventing or staying putrefaction; for therein consisteth the means of conservation of bodies: for bodies have two kinds of dissolutions; the one by consumption and desiccation; the other by putrefaction. But as for the putrefactions of the bodies of men and living creatures, as in agues, worms, consumptions of the lungs, impostumes, and ulcers both inwards and outwards, they are a great part of physic and surgery; and therefore we will reserve the inquiry of them to the proper place, where we shall handle medicinal experiments of all sorts. Of the rest we will now enter into an inquiry: wherein much light may be taken from that which hath been said of the means to induce or accelerate putrefactions: for the removing that which caused putrefaction, doth prevent and avoid putrefaction.

341. The first means of prohibiting or checking putrefaction, is cold: for so we see that meat and drink will last longer unputrified, or unsoured, in winter than in summer: and we see that flowers and

fruits, put in conservatories of snow, keep fresh. And this worketh by the detension of the spirits, and constipation of the tangible parts.

342. The second is astriction: for astriction prohibiteth dissolution: as we see generally in medicines, whereof such as are astringents do inhibit putrefaction: and by the same reason of astringency, some small quantity of oil of vitriol will keep fresh water long from putrifying. And this astriction is in a substance that hath a virtual cold; and it worketh partly by the same means that cold doth.

343. The third is the excluding of the air; and again, the exposing to the air: for these contraries, as it cometh often to pass, work the same effect, according to the nature of the subject matter. So we see, that beer or wine, in bottles close stopped, last long; that the garners under ground keep corn longer than those above ground; and that fruit closed in wax keepeth fresh; and likewise bodies put in honey and flour keep more fresh: and liquors, drinks, and juices, with a little oil cast on the top, keep fresh. Contrariwise, we see that cloth and apparel not aired, do breed moths and mould; and the diversity is, that in bodies that need detention of spirits, the exclusion of the air doth good; as in drinks and corn: but in bodies that need emission of spirits to discharge some of the superfluous moisture, it doth hurt, for they require airing.

344. The fourth is motion and stirring; for putrefaction asketh rest: for the subtle motion which putrefaction requireth, is disturbed by any agitation; and all local motion keepeth bodies integral, and their parts together; as we see that turning over of corn in a garner, or letting it run like an hour-glass, from an upper-room into a lower, doth keep it sweet; and running waters putrify not: and in mens bodies, exercise hindereth putrefaction; and contrariwise, rest and want of motion, or stoppings, whereby the run of humours, or the motion of perspiration is stayed, further putrefaction; as we partly touched a little before.

345. The fifth is, the breathing forth of the adventitious moisture in bodies; for as wetting doth hasten putrefaction, so convenient drying, whereby the more radical moisture is only kept in, putteth back putrefaction; so we see that herbs and flowers, if they be dried in the shade, or dried in the hot sun for a small time, keep best. For the emission of the loose and adventitious moisture doth betray the radical moisture; and carrieth it out for company.

346. The sixth is the strengthening of the spirits of bodies; for as a great heat keepeth bodies from putrefaction, but a tepid heat inclineth them to putrefaction; so a strong spirit likewise preserveth, and a weak or faint spirit disposeth to corruption. So we find that salt water corrupteth not so soon as fresh: and salting of oysters, and powdering of meat, keepeth them from putrefaction. It would be tried also, whether chalk put into water, or drink, doth not preserve it from putrifying or speedy souring. So we see that strong beer will last longer than small; that all things that are hot and aromatical, do help to preserve liquors, or powders, *etc.* which they do as well by strengthening the spirits, as by soaking out the loose moisture.

347. The seventh is separation of the cruder parts, and thereby making the body more equal; for all imperfect mixture is apt to putrify; and watery substances are more apt to putrify than oily. So we see distilled waters will last longer than raw waters; and things that have passed the fire do last longer than those that have not passed the fire; as dried pears, *etc.*

348. The eighth is the drawing forth continually of that part where the putrefaction beginneth; which is, commonly, the loose and watery moisture, not only for the reason before given, that it provoketh the radical moisture to come forth with it; but because being detained in the body, the putrefaction taking hold of it, infecteth the rest, as we see in the embalming dead bodies; and the same reason is of preserving herbs, or fruits, or flowers, in bran or meal.

349. The ninth is the commixture of any thing

that is more oily or sweet: for such bodies are least apt to putrify, the air working little upon them; and they not putrifying, preserve the rest. And therefore we see syrups and ointments will last longer than juices.

350. The tenth is the commixture of somewhat that is dry; for putrefaction beginneth first from the spirits; and then from the moisture: and that that is dry is unapt to putrify: and therefore smoke preserveth flesh; as we see in bacon and neats tongues, and Martlemas beef, *etc.*

351. The opinion of some of the ancients, that blown airs do preserve bodies longer than other airs, seemeth to me probable; for that the blown airs, being overcharged and compressed, will hardly receive the exhaling of any thing, but rather repulse it. It was tried in a blown bladder, whereinto flesh was put, and likewise a flower, and it sorted not: for dry bladders will not blow; and new bladders rather further putrefaction: the way were therefore to blow strongly with a pair of bellows into a hogshead, putting into the hogshead, before, that which you would have preserved; and in the instant that you withdraw the bellows, stop the hole close.

Experiment solitary touching wood shining in the dark.

352. The experiment of wood that shineth in the dark, we have diligently driven and pursued: the rather, for that of all things that give light here below, it is the most durable, and hath least apparent motion. Fire and flame are in continual expence; sugar shineth only while it is in scraping; and salt-water while it is in dashing; glow-worms have their shining while they live, or a little after; only scales of fishes putrified seem to be of the same nature with shining wood: and it is true, that all putrefaction hath with it an inward motion, as well as fire or light. The trial sorted thus: 1. The shining is in some pieces more bright, in some more dim; but the most bright of all doth not attain to the light of a glow-worm. 2. The woods that have been tried to shine,

are chiefly sallow and willow; also the ash and hazle; it may be it holdeth in others. 3. Both roots and bodies do shine, but the roots better. 4. The colour of the shining part, by day-light, is in some pieces white, in some pieces inclining to red; which in the country they call the white and red garnet. 5. The part that shineth is, for the most part, somewhat soft, and moist to feel to; but some was found to be firm and hard, so as it might be figured into a cross, or into beads, *etc.* But you must not look to have an image, or the like, in any thing that is lightsome, for even a face in iron red-hot will not be seen, the light confounding the small differences of lightsome and darksome, which shew the figure. 6. There was the shining part pared off, till you came to that that did not shine; but within two days the part contiguous began also to shine, being laid abroad in the dew; so as it seemeth the putrefaction spreadeth. 7. There was other dead wood of like kind that was laid abroad, which shined not at the first; but after a night's lying abroad began to shine. 8. There was other wood that did first shine; and being laid dry in the house, within five or six days lost the shining; and laid abroad again, recovered the shining. 9. Shining woods being laid in a dry room, within a seven-night lost their shining; but being laid in a cellar, or dark room, kept the shining. 10. The boring of holes in that kind of wood, and then laying it abroad, seemeth to conduce to make it shine: the cause is, for that all solution of continuity doth help on putrefaction, as was touched before. 11. No wood hath been yet tried to shine, that was cut down alive, but such as was rotted both in stock and root while it grew. 12. Part of the wood that shined was steeped in oil, and retained the shining a fortnight. 13. The like succeeded in some steeped in water, and much better. 14. How long the shining will continue, if the wood be laid abroad every night, and taken in and sprinkled with water in the day, is not yet tried. 15. Trial was made of laying it abroad in frosty weather, which hurt it not. 16. There was a great

piece of a root which did shine, and the shining part was cut off till no more shined; yet after two nights, though it were kept in a dry room, it got a shining.

Experiment solitary touching the acceleration of birth.

353. The bringing forth of living creatures may be accelerated in two respects: the one, if the embryo ripeneth and perfecteth sooner: the other, if there be some cause from the mother's body, of expulsion or putting it down: whereof the former is good, and argueth strength; the latter is ill, and cometh by accident or disease. And therefore the ancient observation is true, that the child born in the seventh month doth commonly well; but born in the eighth month, doth for the most part die. But the cause assigned is fabulous; which is, that in the eighth month should be the return of the reign of the planet Saturn, which, as they say, is a planet malign; whereas in the seventh is the reign of the moon, which is a planet propitious. But the true cause is, for that where there is so great a prevention of the ordinary time, it is the lustiness of the child; but when it is less, it is some indisposition of the mother.

Experiment solitary touching the acceleration of growth and stature.

354. To accelerate growth or stature, it must proceed either from the plenty of the nourishment; or from the nature of the nourishment; or from the quickening and exciting of the natural heat. For the first, excess of nourishment is hurtful; for it maketh the child corpulent; and growing in breadth rather then in heighth. And you may take an experiment from plants, which if they spread much are seldom tall. As for the nature of the nourishment; first, it may not be too dry, and therefore children in dairy countries do wax more tall, than where they feed more upon bread and flesh. There is also a received tale; that boiling of daisy roots in milk, which it is certain are great driers, will make dogs little. But so much is true, that an over-dry nourish-

ment in childhood putteth back stature. Secondly, the nourishment must be of an opening nature; for that attenuateth the juice, and furthereth the motion of the spirits upwards. Neither is it without cause, that Xenophon, in the nurture of the Persian children, doth so much commend their feeding upon cardamon; which, he saith, made them grow better, and be of a more active habit. Cardamon is in latin *nasturtium;* and with us water-cresses; which, it is certain, is an herb, that whilst it is young, is friendly to life. As for the quickening of natural heat, it must be done chiefly with exercise; and therefore no doubt much going to school, where they sit so much, hindereth the growth of children; whereas country people that go not to school, are commonly of better stature. And again men must beware how they give children any thing that is cold in operation; for even long sucking doth hinder both wit and stature. This hath been tried, that a whelp that hath been fed with nitre in milk, hath become very little, but extreme lively: for the spirit of nitre is cold. And though it be an excellent medicine in strength of years for prolongation of life; yet it is in children and young creatures an enemy to growth: and all for the same reason; for heat is requisite to growth; but after a man is come to his middle age, heat consumeth the spirits; which the coldness of the spirit of nitre doth help to condense and correct.

Experiments in consort touching sulphur and mercury, two of Paracelsus's principles.

THERE be two great families of things; you may term them by several names; sulphureous and mercurial, which are the chemists words, for as for their *sal*, which is their third principle, it is a compound of the other two; inflammable and not inflammable; mature and crude; oily and watery. For we see that in subterranies there are, as the fathers of their tribes, brimstone and mercury; in vegetables and living creatures there is water and oil: in the inferior order of pneumaticals there is air and flame; and in the

superior there is the body of the star and the pure sky. And these pairs, though they be unlike in the primitive differences of matter, yet they seem to have many consents: for mercury and sulphur are principal materials of metals; water and oil are principal materials of vegetables and animals; and seem to differ but in maturation or concoction: flame, in vulgar opinion, is but air incensed; and they both have quickness of motion, and facility of cession, much alike: and the interstellar sky, though the opinion be vain that the star is the denser part of his orb, hath notwithstanding so much affinity with the star, that there is a rotation of that, as well as of the star. Therefore it is one of the greatest *magnalia naturæ*, to turn water or watery juice into oil or oily juice: greater in nature, than to turn silver or quicksilver into gold.

355. The instances we have wherein crude and watery substance turneth into fat and oily, are of four kinds. First in the mixture of earth and water; which mingled by the help of the sun gather a nitrous fatness, more than either of them have severally; as we see in that they put forth plants, which need both juices.

356. The second is in the assimilation of nourishment, made in the bodies of plants and living creatures; whereof plants turn the juice of mere water and earth into a great deal of oily matter: living creatures, though much of their fat and flesh are out of oily aliments, as meat and bread, yet they assimilate also in a measure their drink of water, *etc.* But these two ways of version of water into oil, namely, by mixture and by assimilation, are by many passages and percolations, and by long continuance of soft heats, and by circuits of time.

357. The third is in the inception of putrefaction; as in water corrupted; and the mothers of waters distilled; both which have a kind of fatness or oil.

358. The fourth is in the dulceration of some metals; as *saccharum Saturni*, etc.

359. The intention of version of water into a more oily substance is by digestion; for oil is almost no-

thing else but water digested; and this digestion is principally by heat; which heat must be either outward or inward: again, it may be by provocation or excitation; which is caused by the mingling of bodies already oily or digested; for they will somewhat communicate their nature with the rest. Digestion also is strongly effected by direct assimilation of bodies crude into bodies digested; as in plants and living creatures, whose nourishment is far more crude than their bodies: but this digestion is by a great compass, as hath been said. As for the more full handling of these two principles, whereof this is but a taste, the inquiry of which is one of the profoundest inquiries of nature, we leave it to the title of version of bodies; and likewise to the title of the first congregations of matter; which, like a general assembly of estates, doth give law to all bodies.

Experiment solitary touching chameleons.

360. A chameleon is a creature about the bigness of an ordinary lizard: his head unproportionably big: his eyes great: he moveth his head without the writhing of his neck, which is inflexible, as a hog doth: his back crooked; his skin spotted with little tumours, less eminent nearer the belly; his tail slender and long: on each foot he hath five fingers; three on the outside, and two on the inside; his tongue of a marvellous length in respect of his body, and hollow at the end; which he will launch out to prey upon flies. Of colour green, and of a dusky yellow, brighter and whiter towards the belly; yet spotted with blue, white and red. If he be laid upon green, the green predominateth; if upon yellow, the yellow; not so if he be laid upon blue, or red, or white; only the green spots receive a more orient lustre; laid upon black, he looketh all black, though not without a mixture of green. He feedeth not only upon air, though that be his principal sustenance, for sometimes he taketh flies, as was said; yet some that have kept chameleons a whole year together, could never perceive that ever they fed upon any thing else

but air; and might observe their bellies to swell after they had exhausted the air, and closed their jaws; which they open commonly against the rays of the sun. They have a foolish tradition in magic, that if a chameleon be burnt upon the top of an house, it will raise a tempest; supposing, according to their vain dreams of sympathies, because he nourisheth with air, his body should have great virtue to make impression upon the air.

Experiment solitary touching subterraneous fires.

361. It is reported by one of the ancients, that in part of Media there are eruptions of flames out of plains; and that those flames are clear, and cast not forth such smoke, and ashes, and pumice, as mountain flames do. The reason, no doubt, is because the flame is not pent as it is in mountains and earthquakes which cast flame. There be also some blind fires under stone, which flame not out, but oil being poured upon them they flame out. The cause whereof is, for that it seemeth the fire is so choked, as not able to remove the stone, it is heat rather than flame; which nevertheless is sufficient to inflame the oil.

Experiment solitary touching nitre.

362. It is reported, that in some lakes the water is so nitrous, as, if foul clothes be put into it, it scoureth them of itself: and if they stay any whit long, they moulder away. And the scouring virtue of nitre is the more to be noted, because it is a body cold; and we see warm water scoureth better than cold. But the cause is, for that it hath a subtle spirit, which severeth and divideth any thing that is foul and viscous, and sticketh upon a body.

Experiment solitary touching congealing of air.

363. Take a bladder, the greatest you can get; fill it full of wind, and tie it about the neck with a silk thread waxed; and upon that put likewise wax very close; so that when the neck of the bladder drieth, no air may possibly get in or out. Then bury it

three or four foot under the earth in a vault, or in a conservatory of snow, the snow being made hollow about the bladder; and after a fortnight's distance, see whether the bladder be shrunk; for if it be, then it is plain that the coldness of the earth or snow hath condensed the air, and brought it a degree nearer to water: which is an experiment of great consequence.

Experiment solitary touching congealing of water into crystal.

364. It is a report of some good credit, that in deep caves there are pensile crystals, and degrees of crystal that drop from above; and in some other, though more rarely, that rise from below: Which though it be chiefly the work of cold, yet it may be that water that passeth through the earth, gathereth a nature more clammy, and fitter to congeal and become solid than water of itself. Therefore trial should be made, to lay a heap of earth, in great frosts, upon a hollow vessel, putting a canvas between, that it falleth not in: and pour water upon it, in such quantity as will be sure to soak through; and see whether it will not make an harder ice in the bottom of the vessel, and less apt to dissolve than ordinarily. I suppose also, that if you make the earth narrower at the bottom than at the top, in fashion of a sugar-loaf reversed, it will help the experiment. For it will make the ice, where it issueth, less in bulk; and evermore smallness of quantity is a help to version.

Experiment solitary touching preserving of rose-leaves both in colour and smell.

365. Take damask roses, and pull them; then dry them upon the top of an house, upon a lead or terras, in the hot sun, in a clear day, between the hours only of twelve and two, or thereabouts. Then put them into a sweet dry earthen bottle or glass, with a narrow mouth, stuffing them close together, but without bruising: stop the bottle or glass close, and these roses will retain not only their smell perfect, but their colour fresh for a year at least. Note, that nothing doth

so much destroy any plant, or other body, either by putrefaction or arefaction, as the adventitious moisture which hangeth loose in the body, if it be not drawn out. For it betrayeth and tolleth forth the innate and radical moisture along with it when itself goeth forth. And therefore in living creatures, moderate sweat doth preserve the juice of the body. Note, that these roses, when you take them from the drying, have little or no smell; so that the smell is a second smell, that issueth out of the flower afterwards.

Experiments in consort touching the continuance of flame.

366. The continuance of flame, according to the diversity of the body inflamed, and other circumstances, is worthy the inquiry; chiefly, for that though flame be almost of a momentary lasting, yet it receiveth the more, and the less: we will first therefore speak at large of bodies inflamed wholly and immediately, without any wick to help the inflammation. A spoonful of spirit of wine, a little heated, was taken, and it burnt as long as came to a hundred and sixteen pulses. The same quantity of spirit of wine, mixed with the sixth part of a spoonful of nitre, burnt but to the space of ninety four pulses. Mixed with the like quantity of bay-salt, eighty three pulses. Mixed with the like quantity of gunpowder, which dissolved into a black water, one hundred and ten pulses. A cube or pellet of yellow wax was taken, as much as half the spirit of wine, and set in the midst, and it burnt only the space of eighty seven pulses. Mixed with the sixth part of a spoonful of milk, it burnt to the space of one hundred pulses; and the milk was curdled. Mixed with the sixth part of a spoonful of water, it burnt to the space of eighty six pulses; with an equal quantity of water, only to the space of four pulses. A small pebble was laid in the midst, and the spirit of wine burnt to the space of ninety four pulses. A piece of wood of the bigness of an arrow, and about a finger's length, was set up in the midst, and the

spirit of wine burnt to the space of ninety four pulses. So that the spirit of wine simple endured the longest; and the spirit of wine with the bay-salt, and the equal quantity of water, were the shortest.

367. Consider well, whether the more speedy going forth of the flame be caused by the greater vigour of the flame in burning; or by the resistance of the body mixed, and the aversion thereof to take flame: which will appear by the quantity of the spirit of wine that remaineth after the going out of the flame. And it seemeth clearly to be the latter; for that the mixture of things least apt to burn, is the speediest in going out. And note, by the way, that spirit of wine burned, till it go out of itself, will burn no more; and tasteth nothing so hot in the mouth as it did; no, nor yet sour, as if it were a degree towards vinegar, which burnt wine doth; but flat and dead.

368. Note, that in the experiment of wax aforesaid, the wax dissolved in the burning, and yet did not incorporate itself with the spirit of wine, to produce one flame; but wheresoever the wax floated, the flame forsook it, till at last it spread all over, and put the flame quite out.

369. The experiments of the mixtures of the spirit of wine inflamed, are things of discovery, and not of use: but now we will speak of the continuance of flames, such as are used for candles, lamps, or tapers; consisting of inflammable matters, and of a wick that provoketh inflammation. And this importeth not only discovery, but also use and profit: for it is a great saving in all such lights, if they can be made as fair and bright as others, and yet last longer. Wax pure made into a candle, and wax mixed severally into candle stuff, with the particulars that follow; *viz.* water, *aqua vitæ*, milk, bay-salt, oil, butter, nitre, brimstone, saw-dust, every of these bearing a sixth part to the wax; and every of these candles mixed, being of the same weight and wick with the wax pure, proved thus in the burning and lasting. The swiftest in consuming was that with saw-dust; which first burned fair till some part of the candle

was consumed, and the dust gathered about the snuff; but then it made the snuff big and long, and to burn duskishly, and the candle wasted in half the time of the wax pure. The next in swiftness were the oil and butter, which consumed by a fifth part swifter than the pure wax. Then followed in swiftness the clear wax itself. Then the bay-salt, which lasted about an eighth part longer than the clear wax. Then followed the *aqua vitæ*, which lasted about a fifth part longer than the clear wax. Then followed the milk and water, with little difference from the *aqua vitæ*, but the water slowest. And in these four last, the wick would spit forth little sparks. For the nitre, it would not hold lighted above some twelve pulses: but all the while it would spit out portions of flame, which afterwards would go out into a vapour. For the brimstone, it would hold lighted much about the same time with the nitre; but then after a little while it would harden and cake about the snuff; so that the mixture of bay-salt with wax will win an eighth part of the time of lasting, and the water a fifth.

370. After the several materials were tried, trial was likewise made of several wicks; as of ordinary cotton, sewing thread, rush, silk, straw, and wood. The silk, straw, and wood, would flame a little, till they came to the wax, and then go out: of the other three, the thread consumed faster than the cotton by a sixth part of time: the cotton next; then the rush consumed slower than the cotton, by at least a third part of time. For the bigness of the flame, the cotton and thread cast a flame much alike; and the rush much less and dimmer. *Query*, whether the wood and wicks both, as in torches, consume faster than the wicks simple?

371. We have spoken of the several materials, and the several wicks: but to the lasting of the flame it importeth also, not only what the material is, but in the same material whether it be hard, soft, old, new, *etc.* Good housewives, to make their candles burn the longer, used to lay them, one by one, in bran or flour, which make them harder, and so they consume

the slower: insomuch as by this means they will outlast other candles of the same stuff almost half in half. For bran and flour have a virtue to harden; so that both age, and lying in the bran, doth help to the lasting. And we see that wax candles last longer than tallow candles, because wax is more firm and hard.

372. The lasting of flame also dependeth upon the easy drawing of the nourishment; as we see in the Court of England, there is a service which they call Allnight; which is as it were a great cake of wax, with the wick in the midst; whereby it cometh to pass, that the wick fetcheth the nourishment farther off. We see also that lamps last longer, because the vessel is far broader than the breadth of a taper or candle.

373. Take a turretted lamp of tin, made in the form of a square; the height of the turret being thrice as much as the length of the lower part whereupon the lamp standeth: make only one hole in it, at the end of the return farthest from the turret. Reverse it, and fill it full of oil by that hole; and then set it upright again; and put a wick in at the hole, and lighten it: you shall find that it will burn slow, and a long time: which is caused, as was said last before, for that the flame fetcheth the nourishment afar off. You shall find also, that as the oil wasteth and descendeth, so the top of the turret by little and little filleth with air; which is caused by the rarefaction of the oil by the heat. It were worthy the observation, to make a hole in the top of the turret, and to try when the oil is almost consumed, whether the air made of the oil, if you put to it a flame of a candle, in the letting of it forth, will inflame. It were good also to have the lamp made, not of tin, but of glass, that you may see how the vapour or air gathereth by degrees in the top.

374. A fourth point that importeth the lasting of the flame, is the closeness of the air wherein the flame burneth. We see, that if wind bloweth upon a candle, it wasteth apace. We see also, it lasteth longer

in a lanthorn than at large. And there are traditions of lamps and candles, that have burnt a very long time in caves and tombs.

375. A FIFTH point that importeth the lasting of the flame, is the nature of the air where the flame burneth; whether it be hot or cold, moist or dry. The air, if it be very cold, irritateth the flame, and maketh it burn more fiercely, as fire scorcheth in frosty weather, and so furthereth the consumption. The air once heated, I conceive, maketh the flame burn more mildly, and so helpeth the continuance. The air, if it be dry, is indifferent: the air, if it be moist, doth in a degree quench the flame, as we see lights will go out in the damps of mines, and howsoever maketh it burn more dully, and so helpeth the continuance.

Experiments in consort touching burials or infusions of divers bodies in earth.

376. BURIALS in earth serve for preservation; and for condensation; and for induration of bodies. And if you intend condensation or induration, you may bury the bodies so as earth may touch them: as if you will make artificial porcellane, *etc.* And the like you may do for conservation, if the bodies be hard and solid; as clay, wood, *etc.* But if you intend preservation of bodies more soft and tender, then you must do one of these two: either you must put them in cases, whereby they may not touch the earth; or else you must vault the earth, whereby it may hang over them, and not touch them: for if the earth touch them, it will do more hurt by the moisture, causing them to putrify, than good by the virtual cold, to conserve them; except the earth be very dry and sandy.

377. AN orange, lemon, and apple, wrapt in a linen cloth, being buried for a fortnight's space four feet deep within the earth, though it were in a moist place and a rainy time, yet came forth no ways mouldy or rotten, but were become a little harder than they were; otherwise fresh in their colour; but their juice

somewhat flatted. But with the burial of a fortnight more they became putrified.

378. A BOTTLE of beer, buried in like manner as before, became more lively, better tasted, and clearer than it was. And a bottle of wine in like manner. A bottle of vinegar so buried came forth more lively and more odoriferous, smelling almost like a violet. And after the whole month's burial, all the three came forth as fresh and lively, if not better than before.

379. IT were a profitable experiment, to preserve oranges, lemons, and pomegranates, till summer; for then their price will be mightily increased. This may be done, if you put them in a pot or vessel well covered, that the moisture of the earth come not at them; or else by putting them in a conservatory of snow. And generally, whosoever will make experiments of cold, let him be provided of three things; a conservatory of snow; a good large vault, twenty feet at least under the ground; and a deep well.

380. THERE hath been a tradition, that pearl and coral, and turquois-stone, that have lost their colours, may be recovered by burying in the earth: which is a thing of great profit, if it would sort: but upon trial of six weeks burial, there followed no effect. It were good to try it in a deep well, or in a conservatory of snow; where the cold may be more constringent; and so make the body more united, and thereby more resplendent.

Experiment solitary touching the affects in men's bodies from several winds.

381. Men's bodies are heavier, and less disposed to motion, when southern winds blow, than when northern. The cause is, for that when the southern winds blow, the humours do, in some degree, melt and wax fluid, and so flow into the parts; as it is seen in wood and other bodies, which, when the southern winds blow, do swell. Besides, the motion and activity of the body consisteth chiefly in the sinews, which, when the southern wind bloweth, are more relax.

Experiment solitary touching winter and summer sicknesses.

382. It is commonly seen, that more are sick in the summer, and more die in the winter; except it be in pestilent diseases, which commonly reign in summer or autumn. The reason is, because diseases are bred, indeed, chiefly by heat; but then they are cured most by sweat and purge; which in the summer cometh on or is provoked more easily. As for pestilent diseases, the reason why most die of them in summer is, because they are bred most in the summer; for otherwise those that are touched are in most danger in the winter.

Experiment solitary touching pestilential seasons.

383. The general opinion is, that years hot and moist are most pestilent; upon the superficial ground that heat and moisture cause putrefaction. In England it is not found true; for many times there have been great plagues in dry years. Whereof the cause may be, for that drought in the bodies of islanders habituated to moist airs, doth exasperate the humours, and maketh them more apt to putrify or inflame: besides, it tainteth the waters, commonly, and maketh them less wholesome. And again in Barbary, the plagues break up in the summer months, when the weather is hot and dry.

Experiment solitary touching an error received about epidemical diseases.

384. Many diseases, both epidemical and others, break forth at particular times. And the cause is falsely imputed to the constitution of the air at that time when they break forth or reign; whereas it proceedeth, indeed, from a precedent sequence and series of the seasons of the year: and therefore Hippocrates in his prognostics doth make good observations of the diseases that ensue upon the nature of the precedent four seasons of the year.

Experiment solitary touching the alteration or preservation of liquors in wells or deep vaults.

385. Trial hath been made with earthen bottles well stopped, hanged in a well of twenty fathom deep at the least; and some of the bottles have been let down into the water, some others have hanged above, within about a fathom of the water; and the liquors so tried have been beer, not new, but ready for drinking, and wine, and milk. The proof hath been, that both the beer and the wine, as well within water as above, have not been palled or deadened at all; but as good or somewhat better than bottles of the same drinks and staleness kept in a cellar. But those which did hang above water were apparently the best; and that beer did flower a little; whereas that under water did not, though it were fresh. The milk soured and began to putrify. Nevertheless it is true, that there is a village near Blois, where in deep caves they do thicken milk, in such sort that it becometh very pleasant: which was some cause of this trial of hanging milk in the well: but our proof was naught; neither do I know whether that milk in those caves be first boiled. In were good therefore to try it with milk sodden, and with cream; for that milk of itself is such a compound body, of cream, curds, and whey, as it is easily turned and dissolved. It were good also to try the beer when it is in wort, that it may be seen whether the hanging in the well will accelerate the ripening and clarifying of it.

Experiment solitary touching stuttering.

386. Divers we see do stutter. The cause may be, in most, the refrigeration of the tongue; whereby it is less apt to move. And therefore we see that naturals do generally stutter: and we see that in those that stutter, if they drink wine moderately, they stutter less, because it heateth: and so we see, that they that stutter do stutter more in the first offer to speak than in continuance; because the tongue is by motion somewhat heated. In some also, it may be, though rarely, the dryness of the tongue; which likewise maketh it less apt to move as well as cold: for

it is an effect that cometh to some wise and great men; as it did unto Moses, who was *linguæ præpeditæ;* and many stutterers, we find, are very choleric men; choler inducing a dryness in the tongue.

Experiments in consort touching smells.

387. Smells and other odours are sweeter in the air at some distance, than near the nose; as hath been partly touched heretofore. The cause is double: first, the finer mixture or incorporation of the smell: for we see that in sounds likewise, they are sweetest when we cannot hear every part by itself. The other reason is, for that all sweet smells have joined with them some earthy or crude odours; and at some distance the sweet, which is the more spiritual, is perceived, and the earthy reacheth not so far.

388. Sweet smells are most forcible in dry substances when they are broken; and so likewise in oranges or lemons, the nipping of their rind giveth out their smell more; and generally when bodies are moved or stirred, though not broken, they smell more; as a sweet bag waved. The cause is double: the one, for that there is a greater emission of the spirit when way is made; and this holdeth in the breaking, nipping, or crushing; it holdeth also, in some degree, in the moving: but in this last there is a concurrence of the second cause; which is the impulsion of the air, that bringeth the scent faster upon us.

389. The daintiest smells of flowers are out of those plants whose leaves smell not; as violets, roses, wall-flowers, gilly-flowers, pinks, woodbines, vine-flowers, apple-blooms, limetree-blooms, bean-blooms, *etc.* The cause is, for that where there is heat and strength enough in the plant to make the leaves odorate, there the smell of the flower is rather evanid and weaker than that of the leaves; as it is in rosemary flowers, lavender-flowers, and sweet-briar roses. But where there is less heat, there the spirit of the plant is digested and refined and severed from the grosser juice, in the efflorescence, and not before.

390. Most odours smell best broken or crushed, as hath been said; but flowers pressed or beaten do lose the freshness and sweetness of their odour. The

cause is, for that when they are crushed, the grosser and more earthy spirit cometh out with the finer, and troubleth it; whereas in stronger odours there are no such degrees of the issue of the smell.

Experiments in consort touching the goodness and choice of water.

391. It is a thing of very good use to discover the goodness of waters. The taste, to those that drink water only, doth somewhat: but other experiments are more sure. First, try waters by weight; wherein you may find some difference, though not much: and the lighter you may account the better.

392. Secondly, try them by boiling upon an equal fire; and that which consumeth away fastest, you may account the best.

393. Thirdly, try them in several bottles or open vessels, matches in every thing else, and see which of them last longest without stench or corruption. And that which holdeth unputrified longest, you may likewise account the best.

394. Fourthly, try them by making drinks stronger or smaller, with the same quantity of malt; and you may conclude, that that water which maketh the stronger drink, is the more concocted and nourishing; though perhaps it be not so good for medicinal use. And such water, commonly, is the water of large and navigable rivers; and likewise in large and clean ponds of standing water; for upon both them the sun hath more power than upon fountains or small rivers. And I conceive that chalk-water is next them the best for going farthest in drink: for that also helpeth concoction; so it be out of a deep well; for then it cureth the rawness of the water; but chalky water, towards the top of the earth, is too fretting; as it appeareth in laundry of cloths, which wear out apace if you use such waters.

395. Fifthly, the housewives do find a difference in waters, for the bearing or not bearing of soap: and it is likely that the more fat water will bear soap best; for the hungry water doth kill the unctuous nature of the soap.

396. Sixthly, you may make a judgment of waters according to the place whence they spring or come: the rain-water is, by the physicians, esteemed the finest and the best; but yet it is said to putrify soonest; which is likely, because of the fineness of the spirit: and in conservatories of rain-water, such as they have in Venice, *etc.* they are found not so choice waters; the worse, perhaps, because they are covered aloft, and kept from the sun. Snow-water is held unwholsome; insomuch as the people that dwell at the foot of the snow mountains, or otherwise upon the ascent, especially the women, by drinking of snow-water, have great bags hanging under their throats. Well-water, except it be upon chalk, or a very plentiful spring, maketh meat red; which is an ill sign. Springs on the tops of high hills are the best: for both they seem to have a lightness and appetite of mounting; and besides, they are most pure and unmingled; and again, are more percolated through a great space of earth. For waters in valleys join, in effect, under ground, with all waters of the same level; whereas springs on the tops of hills pass through a great deal of pure earth, with less mixture of other waters.

397. Seventhly, judgment may be made of waters by the soil whereupon the water runneth; as pebble is the cleanest and best tasted, and next to that clay-water; and thirdly, water upon chalk; fourthly, that upon sand; and worst of all upon mud. Neither may you trust waters that taste sweet; for they are commonly found in rising grounds of great cities, which must needs take in a great deal of filth.

Experiment solitary touching the temperate heat under the equinoctial.

398. In Peru, and divers parts of the West Indies, though under the line, the heats are not so intolerable as they be in Barbary, and the skirts of the torrid zone. The causes are, first the great breezes which the motion of the air in great circles, such as are under the girdle of the world, produceth; which do refrige-

rate; and therefore in those parts noon is nothing so hot, when the breezes are great, as about nine or ten of the clock in the forenoon. Another cause is, for that the length of the night, and the dews thereof, do compensate the heat of the day. A third cause is the stay of the sun; not in respect of day and night, for that we spake of before, but in respect of the season; for under the line the sun crosseth the line, and maketh two summers and two winters, but in the skirts of the torrid zone it doubleth and goeth back again, and so maketh one long summer.

399. The heat of the sun maketh men black in some countries, as in Æthiopia and Guiney, *etc.* Fire doth it not, as we see in glass-men, that are continually about the fire. The reason may be, because fire doth lick up the spirits and blood of the body, so as they exhale; so that it ever maketh men look pale and sallow; but the sun, which is a gentler heat, doth but draw the blood to the outward parts; and rather concocteth it than soaketh it; and therefore we see that all Æthiopes are fleshy and plump, and have great lips; all which betoken moisture retained, and not drawn out. We see also, that the Negroes are bred in countries that have plenty of water by rivers or otherwise: for Meroë, which was the metropolis of Æthiopia, was upon a great lake; and Congo, where the Negroes are, is full of rivers. And the confines of the river Niger, where the Negroes also are, are well watered: and the region above Cape Verde is likewise moist, insomuch as it is pestilent through moisture: but the countries of the Abyssenes, and Barbary, and Peru, where they are tawny, and olivaster, and pale, are generally more sandy and dry. As for the Æthiopes, as they are plump and fleshy, so, it may be, they are sanguine and ruddy-coloured, if their black skin would suffer it to be seen.

Experiment solitary touching motion after the instant of death.

400. Some creatures do move a good while after their head is off; as birds: some a very little time;

as men and all beasts: some move, though cut in several pieces; as snakes, eels, worms, flies. *etc.* First therefore it is certain, that the immediate cause of death is the resolution or extinguishment of the spirits; and that the destruction or corruption of the organs is but the mediate cause. But some organs are so peremptorily necessary, that the extinguishment of the spirits doth speedily follow; but yet so as there is an interim of a small time. It is reported by one of the ancients of credit, that a sacrificed beast hath lowed after the heart hath been severed; and it is a report also of credit, that the head of a pig hath been opened, and the brain put into the palm of a man's hand, trembling, without breaking any part of it, or severing it from the marrow of the back-bone; during which time the pig hath been, in all appearance, stark dead, and without motion; and after a small time the brain hath been replaced, and the skull of the pig closed, and the pig hath a little after gone about. And certain it is, that an eye upon revenge hath been thrust forth, so as it hanged a pretty distance by the visual nerve; and during that time the eye hath been without any power of sight; and yet after being replaced recovered sight. Now the spirits are chiefly in the head and cells of the brain, which in men and beasts are large; and therefore, when the head is off, they move little or nothing. But birds have small heads, and therefore the spirits are a little more dispersed in the sinews, whereby motion remaineth in them a little longer; insomuch, as it is extant in story, that an emperor of Rome, to shew the certainty of his hand, did shoot a great forked arrow at an ostrich, as she ran swiftly upon the stage, and struck off her head; and yet she continued the race a little way with the head off. As for worms, and flies, and eels, the spirits are diffused almost all over; and therefore they move in their several pieces.

NATURAL HISTORY.

CENTURY V.

Experiments in consort touching the acceleration of germination.

WE will now inquire of plants or vegetables: and we shall do it with diligence. They are the principal part of the third day's work. They are the first *producat*, which is the word of animation: for the other words are but the words of essence. And they are of excellent and general use for food, medicine, and a number of mechanical arts.

401. THERE were sown in a bed, turnip-seed, radish-seed, wheat, cucumber-seed, and peas. The bed we call a hot-bed, and the manner of it is this: there was taken horse-dung, old and well rotted; this was laid upon a bank half a foot high, and supported round about with planks; and upon the top was cast sifted earth, some two fingers deep; and then the seed sprinkled upon it, having been steeped all night in water mixed with cow-dung. The turnip-seed and the wheat came up half an inch above ground within two days after, without any watering. The rest the third day. The experiment was made in October; and, it may be, in the spring, the accelerating would have been the speedier. This is a noble experiment; for without this help they would have been four times as long in coming up. But there doth not occur to me, at this present, any use thereof for profit; except it should be for sowing of peas, which have their price very much increased by the early coming. It may be tried also with cherries, strawberries, and other fruit, which are dearest when they come early.

402. THERE was wheat steeped in water mixed with cow-dung; other in water mixed with horse-

dung; other in water mixed with pigeon dung; other in urine of man; other in water mixed with chalk powdered; other in water mixed with soot; other in water mixed with ashes; other in water mixed with bay-salt; other in claret wine; other in malmsey; other in spirit of wine. The proportion of the mixture was a fourth part of the ingredients to the water; save that there was not of the salt above an eighth part. The urine, and wines, and spirit of wine, were simple without mixture of water. The time of the steeping was twelve hours. The time of the year October. There was also other wheat sown unsteeped, but watered twice a day with warm water. There was also other wheat sown simple, to compare it with the rest. The event was; that those that were in the mixture of dung, and urine, and soot, chalk, ashes, and salt, came up within six days: and those that afterwards proved the highest, thickest, and most lusty, were first the urine; and then the dungs; next the chalk; next the soot; next the ashes; next the salt; next the wheat simple of itself, unsteeped and unwatered; next the watered twice a day with warm water; next the claret wine. So that these three last were slower than the ordinary wheat of itself; and this culture did rather retard than advance. As for those that were steeped in malmsey, and spirit of wine, they came not up at all. This is a rich experiment for profit; for the most of the steepings are cheap things; and the goodness of the crop is a great matter of gain; if the goodness of the crop answer the earliness of the coming up; as it is like it will; both being from the vigour of the seed; which also partly appeared in the former experiments, as hath been said. This experiment should be tried in other grains, seeds, and kernels: for it may be some steeping will agree best with some seeds. It should be tried also with roots steeped as before, but for longer time. It should be tried also in several seasons of the year, especially the spring.

403. Strawberries watered now and then, as once in three days, with water wherein hath been steeped sheeps-dung or pigeons-dung, will prevent

and come early. And it is like the same effect would follow in other berries, herbs, flowers, grains, or trees. And therefore it is an experiment, though vulgar in strawberries, yet not brought into use generally: for it is usual to help the ground with muck; and likewise to recomfort it sometimes with muck put to the roots; but to water it with muck water, which is like to be more forcible, is not practised.

404. Dung, or chalk, or blood, applied in substance, seasonably, to the roots of trees, doth set them forwards. But to do it unto herbs, without mixture of water or earth, it may be these helps are too hot.

405. The former means of helping germination, are either by the goodness and strength of the nourishment; or by the comforting and exciting the spirits in the plant, to draw the nourishment better. And of this latter kind, concerning the comforting of the spirits of the plant, are also the experiments that follow; though they be not applications to the root or seed. The planting of trees warm upon a wall against the south, or south-east sun, doth hasten their coming on and ripening; and the south-east is found to be better than the south-west, though the south-west be the hotter coast. But the cause is chiefly, for that the heat of the morning succeedeth the cold of the night: and partly, because many times the south-west sun is too parching. So likewise the planting of them upon the back of a chimney where a fire is kept, doth hasten their coming on and ripening: nay more, the drawing of the boughs into the inside of a room where a fire is continually kept, worketh the same effect; which hath been tried with grapes; insomuch as they will come a month earlier than the grapes abroad.

406. Besides the two means of accelerating germination formerly described; that is to say, the mending of the nourishment; and comforting of the spirit of the plant; there is a third, which is the making way for the easy coming to the nourishment, and drawing it. And therefore gentle digging and loosening of the earth about the roots of trees; and the removing herbs and flowers into new earth once in

two years, which is the same thing, for the new earth is ever looser, doth greatly further the prospering and earliness of plants.

407. But the most admirable acceleration by facilitating the nourishment is that of water. For a standard of a damask rose with the root on, was set in a chamber where no fire was, upright in an earthen pan, full of fair water, without any mixture, half a foot under the water, the standard being more than two foot high above the water: within the space of ten days the standard did put forth a fair green leaf, and some other little buds, which stood at a stay, without any shew of decay or withering, more than seven days. But afterwards that leaf faded, but the young buds did sprout on; which afterward opened into fair leaves in the space of three months; and continued so a while after, till upon removal we left the trial. But note, that the leaves were somewhat paler and lighter-coloured than the leaves used to be abroad. Note, that the first buds were in the end of October; and it is likely that if it had been in the spring time, it would have put forth with greater strength, and, it may be, to have grown on to bear flowers. By this means you may have, as it seemeth, roses set in the midst of a pool, being supported with some stay; which is matter of rareness and pleasure, though of small use. This is the more strange, for that the like rose-standard was put at the same time into water mixed with horse-dung, the horse-dung about the fourth part to the water, and in four months space, while it was observed, put not forth any leaf, though divers buds at the first, as the other.

408. A Dutch flower that had a bulbous root, was likewise put at the same time all under water, some two or three fingers deep; and within seven days sprouted, and continued long after further growing. There were also put in, a beet-root; a borage-root, and a radish root, which had all their leaves cut almost close to the roots; and within six weeks had fair leaves; and so continued till the end of November.

409. Note, that if roots or peas, or flowers, may

be accelerated in their coming and ripening, there is a double profit; the one in the high price that those things bear when they come early: the other in the swiftness of their returns: for in some grounds which are strong, you shall have a radish, *etc.* come in a month, that in other grounds will not come in two, and so make double returns.

410. Wheat also was put into the water, and came not forth at all; so as it seemeth there must be some strength and bulk in the body put into the water, as it is in roots; for grains, or seeds, the cold of the water will mortify. But casually some wheat lay under the pan, which was somewhat moistened by the suing of the pan; which in six weeks, as aforesaid, looked mouldy to the eye, but it was sprouted forth half a finger's length.

411. It seemeth by these instances of water, that for nourishment the water is almost all in all, and that the earth doth but keep the plant upright, and save it from over-heat and over-cold; and therefore is a comfortable experiment for good drinkers. It proveth also that our former opinion, that drink incorporate with flesh or roots, as in capon-beer, *etc.* will nourish more easily, than meat and drink taken severally.

412. The housing of plants, I conceive, will both accelerate germination, and bring forth flowers and plants in the colder seasons: and as we house hot-country plants, as lemons, oranges, myrtles, to save them; so we may house our own country plants, to forward them, and make them come in the cold seasons; in such sort, that you may have violets, strawberries, peas, all winter: so that you sow or remove them at fit times. This experiment is to be referred unto the comforting of the spirit of the plant by warmth, as well as housing their boughs, *etc.* So then the means to accelerate germination, are in particular eight, in general three.

Experiments in consort touching the putting back or retardation of germination.

413. To make roses, or other flowers come late, it is an experiment of pleasure. For the ancients

esteemed much of *rosa serâ*. And indeed the November rose is the sweetest, having been less exhaled by the sun. The means are these. First, the cutting off their tops immediately after they have done bearing; and then they will come again the same year about November: but they will not come just on the tops where they were cut, but out of those shoots which were, as it were, water boughs. The cause is, for that the sap, which otherwise would have fed the top, though after bearing, will, by the discharge of that, divert unto the side sprouts; and they will come to bear, but later.

414. The second is the pulling off the buds of the rose, when they are newly knotted; for then the side branches will bear. The cause is the same with the former; for cutting off the tops, and pulling off the buds, work the same effect, in retention of the sap for a time, and diversion of it to the sprouts that were not so forward.

415. The third is the cutting off some few of the top boughs in the spring time, but suffering the lower boughs to grow on. The cause is, for that the boughs do help to draw up the sap more strongly; and we see that in polling of trees, many do use to leave a bough or two on the top, to help to draw up the sap. And it is reported also, that if you graft upon the bough of a tree, and cut off some of the old boughs, the new cions will perish.

416. The fourth is by laying the roots bare about Christmas some days. The cause is plain, for that it doth arrest the sap from going upwards for a time; which arrest is afterwards released by the covering of the root again with earth; and then the sap getteth up, but later.

417. The fifth is the removing of the tree some month before it buddeth. The cause is, for that some time will be required after the remove for the resettling, before it can draw the juice; and that time being lost, the blossom must needs come forth later.

418. The sixth is the grafting of roses in May, which commonly gardeners do not till July; and then

they bear not till the next year; but if you graft them in May, they will bear the same year, but late.

419. The seventh is the girding of the body of the tree about with some pack-thread; for that also in a degree restraineth the sap, and maketh it come up more late and more slowly.

420. The eighth is the planting of them in a shade, or in a hedge; the cause is, partly the keeping out of the sun, which hasteneth the sap to rise; and partly the robbing of them of nourishment by the stuff in the hedge. These means may be practised upon other, both trees and flowers, *mutatis mutandis*.

421. Men have entertained a conceit that sheweth prettily; namely, that if you graft a late-coming fruit upon a stock of a fruit-tree that cometh early, the graft will bear fruit early; as a peach upon a cherry; and contrariwise, if an early-coming fruit upon a stock of a fruit-tree that cometh late, the graft will bear fruit late; as a cherry upon a peach. But these are but imaginations, and untrue. The cause is, for that the cion over-ruleth the stock quite; and the stock is but passive only, and giveth aliment, but no motion to the graft.

Experiments in consort touching the melioration of fruits, trees, and plants.

We will speak now, how to make fruits, flowers, and roots larger, in more plenty, and sweeter than they use to be; and how to make the trees themselves more tall, more spread, and more hasty and sudden than they use to be. Wherein there is no doubt but the former experiments of acceleration will serve much to these purposes. And again, that these experiments, which we shall now set down, do serve also for acceleration, because both effects proceed from the increase of vigour in the tree; but yet to avoid confusion, and because some of the means are more proper for the one effect, and some for the other, we will handle them apart.

422. It is an assured experience, that an heap of flint or stone, laid about the bottom of a wild tree, as an oak, elm, ash, *etc.* upon the first planting, doth

make it prosper double as much as without it. The cause is, for that it retaineth the moisture which falleth at any time upon the tree, and suffereth it not to be exhaled by the sun. Again, it keepeth the tree warm from cold blasts and frosts, as it were in an house. It may be also there is somewhat in the keeping of it steady at the first. *Query*, If laying of straw some height about the body of a tree, will not make the tree forwards. For though the root giveth the sap, yet it is the body that draweth it. But you must note, that if you lay stones about the stalk of lettuce, or other plants that are more soft, it will over-moisten the roots, so as the worms will eat them.

423. A TREE, at the first setting, should not be shaken, until it hath taken root fully: and therefore some have put two little forks about the bottom of their trees to keep them upright; but after a year's rooting, then shaking doth the tree good, by loosening of the earth, and, perhaps, by exercising as it were, and stirring the sap of the tree.

424. GENERALLY the cutting away of boughs and suckers at the root and body doth make trees grow high; and contrariwise, the polling and cutting of the top maketh them grow spread and bushy. As we see in pollards, *etc.*

425. IT is reported, that to make hasty-growing coppice woods, the way is, to take willow, sallow, poplar, alder, of some seven years growth; and to set them, not upright but aslope, a reasonable depth under the ground; and then instead of one root they will put forth many, and so carry more shoots upon a stem.

426. WHEN you would have many new roots of fruit trees, take a low tree and bow it, and lay all his branches aflat upon the ground, and cast earth upon them; and every twig will take root. And this is a very profitable experiment for costly trees, for the boughs will make stocks without charge; such as are apricots, peaches, almonds, cornelians, mulberries, figs, *etc.* The like is continually practised with vines, roses, musk-roses, *etc.*

427. From May to July you may take off the bark of any bough, being of the bigness of three or four inches, and cover the bare place, somewhat above and below, with loam well tempered with horse-dung, binding it fast down. Then cut off the bough about Allhollontide in the bare place, and set it in the ground; and it will grow to be a fair tree in one year. The cause may be, for that the baring from the bark keepeth the sap from descending towards winter, and so holdeth it in the bough; and it may be also that the loam and horse-dung applied to the bare place do moisten it, and cherish it, and make it more apt to put forth the root. Note, that this may be a general means for keeping up the sap of trees in their boughs: which may serve to other effects.

428. It hath been practised in trees that shew fair and bear not, to bore a hole through the heart of the tree, and thereupon it will bear. Which may be, for that the tree before had too much repletion, and was oppressed with its own sap; for repletion is an enemy to generation.

429. It hath been practised in trees that do not bear, to cleave two or three of the chief roots, and to put into the cleft a small pebble, which may keep it open, and then it will bear. The cause may be, for that a root of a tree may be, as it were, hide-bound, no less than the body of the tree; but it will not keep open without somewhat put into it.

430. It is usually practised, to set trees that require much sun upon walls against the south; as apricots, peaches, plums, vines, figs, and the like. It hath a double commodity; the one, the heat of the wall by reflexion; the other, the taking away of the shade; for when a tree groweth round, the upper boughs over-shadow the lower: but when it is spread upon a wall, the sun cometh alike upon the upper and lower branches.

431. It hath also been practised by some, to pull off some leaves from the trees so spread, that the sun may come upon the bough and fruit the better. There

hath been practised also a curiosity, to set a tree upon the north side of a wall, and at a little height to draw it through the wall, and spread it upon the south side: conceiving that the root and lower part of the stock should enjoy the freshness of the shade; and the upper boughs, and fruit, the comfort of the sun. But it sorted not; the cause is, for that the root requireth some comfort from the sun, though under earth, as well as the body: and the lower part of the body more than the upper, as we see in compassing a tree below with straw.

432. The lowness of the bough where the fruit cometh, maketh the fruit greater, and to ripen better; for you shall ever see, in apricots, peaches, or melocotones upon a wall, the greatest fruits towards the bottom. And in France, the grapes that make the wine, grow upon low vines bound to small stakes; and the raised vines in arbours make but verjuice. It is true, that in Italy and other countries where they have hotter sun, they raise them upon elms and trees; but I conceive, if the French manner of planting low were brought in use there, their wines would be stronger and sweeter. But it is more chargeable in respect of the props. It were good to try whether a tree grafted somewhat near the ground, and the lower boughs only maintained, and the higher continually pruned off, would not make a larger fruit.

433. To have fruit in greater plenty, the way is to graft not only upon young stocks, but upon divers boughs of an old tree; for they will bear great numbers of fruit: whereas if you graft but upon one stock, the tree can bear but few.

434. The digging yearly about the roots of trees, which is a great means both to the acceleration and melioration of fruits, is practised in nothing but in vines: which if it were transferred unto other trees and shrubs, as roses, *etc.* I conceive would advance them likewise.

435. It hath been known, that a fruit tree hath been blown up almost by the roots, and set up again, and the next year bear exceedingly. The cause of

this was nothing but the loosening of the earth, which comforteth any tree, and is fit to be practised more than it is in fruit-trees: for trees cannot be so fitly removed into new grounds, as flowers and herbs may.

436. To revive an old tree, the digging of it about the roots, and applying new mould to the roots, is the way. We see also that draught-oxen put into fresh pasture gather new and tender flesh; and in all things better nourishment than hath been used doth help to renew; especially if it be not only better, but changed and differing from the former.

437. If an herb be cut off from the roots in the beginning of winter, and then the earth be trodden and beaten down hard with the foot and spade, the roots will become of very great magnitude in summer. The reason is, for that the moisture being forbidden to come up in the plant, stayeth longer in the root, and so dilateth it. And gardeners use to tread down any loose ground after they have sown onions, or turnips, *etc.*

438. If *panicum* be laid below and about the bottom of a root, it will cause the root to grow to an excessive bigness. The cause is, for that being itself of a spongy substance, it draweth the moisture of the earth to it, and so feedeth the root. This is of greatest use for onions, turnips, parsnips, and carrots.

439. The shifting of ground is a means to better the tree and fruit; but with this caution, that all things do prosper best when they are advanced to the better: your nursery of stocks ought to be in a more barren ground than the ground is whereunto you remove them. So all grasiers prefer their cattle from meaner pastures to better. We see also, that hardness in youth lengtheneth life, because it leaveth a cherishing to the better of the body in age: nay, in exercises, it is good to begin with the hardest, as dancing in thick shoes, *etc.*

440. It hath been observed, that hacking of trees in their bark, both downright and across, so as you may make them rather in slices than in continued

hacks, doth great good to trees; and especially delivereth them from being hide-bound, and killeth their moss.

441. Shade to some plants conduceth to make them large and prosperous, more than sun; as in strawberries and bays, *etc.* Therefore among strawberries sow here and there some borage seed; and you shall find the strawberries under those leaves far more large than their fellows. And bays you must plant to the north, or defend them from the sun by a hedge-row; and when you sow the berries, weed not the borders for the first half year; for the weed giveth them shade.

442. To increase the crops of plants, there would be considered not only the increasing the lust of the earth, or of the plant, but the saving also of that which is spilt. So they have lately made a trial to set wheat; which nevertheless hath been left off, because of the trouble and pains: yet so much is true, that there is much saved by the setting, in comparison of that which is sown; both by keeping it from being picked up by birds, and by avoiding the shallow lying of it, whereby much that is sown taketh no root.

443. It is prescribed by some of the ancients, that you take small trees, upon which figs or other fruit grow, being yet unripe, and cover the trees in the middle of autumn with dung until the spring; and then take them up in a warm day, and replant them in good ground; and by that means the former year's tree will be ripe, as by a new birth, when other trees of the same kind do but blossom. But this seemeth to have no great probability.

444. It is reported, that if you take nitre, and mingle it with water, to the thickness of honey, and therewith anoint the bud after the vine is cut, it will sprout forth within eight days. The cause is like to be, if the experiment be true, the opening of the bud and of the parts contiguous, by the spirit of the nitre; for nitre is, as it were, the life of vegetables.

445. Take seed, or kernels of apples, pears, oranges; or a peach, or a plumstone, *etc.* and put

them into a squill, which is like a great onion, and they will come up much earlier than in the earth itself. This I conceive to be as a kind of grafting in the root; for as the stock of a graft yieldeth better prepared nourishment to the graft, than the crude earth; so the squill doth the like to the seed. And I suppose the same would be done, by putting kernels into a turnip, or the like; save that the squill is more vigorous and hot. It may by tried also, with putting onion-seed into an onion-head, which thereby, perhaps, will bring forth a larger and earlier onion.

446. The pricking of a fruit in several places, when it is almost at its bigness, and before it ripeneth, hath been practised with success, to ripen the fruit more suddenly. We see the example of the biting of wasps or worms upon fruit, whereby it manifestly ripeneth the sooner.

447. It is reported, that *alga marina*, sea-weed, put under the roots of coleworts, and, perhaps, of other plants, will further their growth. The virtue, no doubt, hath relation to salt, which is a great help to fertility.

448. It hath been practised, to cut off the stalks of cucumbers, immediately after their bearing, close by the earth; and then to cast a pretty quantity of earth upon the plant that remaineth, and they will bear the next year fruit long before the ordinary time. The cause may be, for that the sap goeth down the sooner, and is not spent in the stalk or leaf, which remaineth after the fruit. Where note, that the dying in the winter of the roots of plants that are annual, seemeth to be partly caused by the over-expence of the sap into stalk and leaves; which being prevented, they will super-annuate, if they stand warm.

449. The pulling off many of the blossoms from a fruit-tree, doth make the fruit fairer. The cause is manifest; for that the sap hath the less to nourish. And it is a common experience, that if you do not pull off some blossoms the first time a tree bloometh, it will blossom itself to death.

450. It were good to try, what would be the effect, if all the blossoms were pulled from a fruit-tree; or

the acorns and chesnut-buds, *etc.* from a wild tree, for two years together. I suppose that the tree will either put forth the third year bigger and more plentiful fruit; or else, the same years, larger leaves, because of the sap stored up.

451. It hath been generally received, that a plant watered with warm water, will come up sooner and better than with cold water or with showers. But our experiment of watering wheat with warm water, as hath been said, succeeded not; which may be, because the trial was too late in the year, namely, in the end of October. For the cold then coming upon the seed, after it was made more tender by the warm water, might check it.

452. There is no doubt, but that the grafting, for the most part, doth meliorate the fruit. The cause is manifest; for that the nourishment is better prepared in the stock, than in the crude earth: but yet note well, that there be some trees that are said to come up more happily from the kernel than from the graft; as the peach and melocotone. The cause I suppose to be, for that those plants require a nourishment of great moisture; and though the nourishment of the stock be finer and better prepared, yet it is not so moist and plentiful as the nourishment of the earth. And indeed we see those fruits are very cold fruits in their nature.

453. It hath been received, that a smaller pear grafted upon a stock that beareth a greater pear, will become great. But I think it is as true as that of the prime fruit upon the late stock; and *e converso;* which we rejected before: for the cion will govern. Nevertheless, it is probable enough, that if you can get a cion to grow upon a stock of another kind, that is much moister than its own stock, it may make the fruit greater, because it will yield more plentiful nourishment; though it is like it will make the fruit baser. But generally the grafting is upon a drier stock; as the apple upon a crab; the pear upon a thorn, *etc.* Yet it is reported, that in the Low-Countries they will graft an apple cion upon the stock of a colewort,

and it will bear a great flaggy apple; the kernel of which, if it be set, will be a colewort, and not an apple. It were good to try whether an apple cion will prosper if it be grafted upon a sallow, or upon a poplar, or upon an alder, or upon an elm, or upon an horse-plum, which are the moistest of trees. I have heard that it hath been tried upon an elm, and succeeded.

454. It is manifest by experience, that flowers removed wax greater, because the nourishment is more easily come by in the loose earth. It may be, that oft regrafting of the same cion may likewise make fruit greater; as if you take a cion, and graft it upon a stock the first year; and then cut it off, and graft it upon another stock the second year; and so for a third or fourth year; and then let it rest, it will yield afterward, when it beareth, the greater fruit.

Of grafting there are many experiments worth the noting, but those we reserve to a proper place.

455. It maketh figs better, if a fig-tree, when it beginneth to put forth leaves, have his top cut off. The cause is plain, for that the sap hath the less to feed, and the less way to mount: but it may be the fig will come somewhat later, as was formerly touched. The same may be tried likewise in other trees.

456. It is reported, that mulberries will be fairer, and the trees more fruitful, if you bore the trunk of the tree through in several places, and thrust into the places bored wedges of some hot trees, as turpentine, mastic-tree, guaiacum, juniper, *etc.* The cause may be, for that adventive heat doth chear up the native juice of the tree.

457. It is reported, that trees will grow greater, and bear better fruit, if you put salt, or lees of wine, or blood to the root. The cause may be the increasing the lust or spirit of the root; these things being more forcible than ordinary composts.

458. It is reported by one of the ancients, that artichokes will be less prickly, and more tender, if the seeds have their tops dulled, or grated off upon a stone.

459. Herbs will be tenderer and fairer, if you take them out of beds, when they are newly come up, and remove them into pots with better earth. The remove from bed to bed was spoken of before; but that was in several years; this is upon the sudden. The cause is the same with other removes formerly mentioned.

460. Coleworts are reported by one of the ancients to prosper exceedingly, and to be better tasted, if they be sometimes watered with salt water; and much more with water mixed with nitre; the spirit of which is less adurent than salt.

461. It is reported that cucumbers will prove more tender and dainty, if their seeds be steeped a little in milk; the cause may be, for that the seed being mollified with the milk, will be too weak to draw the grosser juice of the earth, but only the finer. The same experiment may be made in artichokes and other seeds, when you would take away either their flashiness or bitterness. They speak also, that the like effect followeth of steeping in water mixed with honey; but that seemeth to me not so probable, because honey hath too quick a spirit.

462. It is reported, that cucumbers will be less watery, and more melon-like, if in the pit where you set them, you fill it, half-way up, with chaff or small sticks, and then pour earth upon them; for cucumbers, as it seemeth, do extremely affect moisture, and over-drink themselves; which this chaff or chips forbiddeth. Nay, it is farther reported, that if, when a cucumber is grown, you set a pot of water about five or six inches distance from it, it will, in twenty-four hours shoot so much out as to touch the pot; which, if it be true, is an experiment of an higher nature than belongeth to this title: for it discovereth perception in plants, to move towards that which should help and comfort them, though it be at a distance. The ancient tradition of the vine is far more strange; it is, that if you set a stake or prop some distance from it, it will grow that way; which is far stranger, as is said, than the other: for that water may work by a sympathy of attraction; but this of the stake seemeth to be a reasonable discourse.

463. It hath been touched before, that terebration of trees doth make them prosper better. But it is found also, that it maketh the fruit sweeter and better. The cause is, for that, notwithstanding the terebration, they may receive aliment sufficient, and yet no more than they can well turn and digest; and withal do sweat out the coarsest and unprofitablest juice; even as it is in living creatures, which by moderate feeding, and exercise, and sweat, attain the soundest habit of body.

464. As terebration doth meliorate fruit, so upon the like reason doth letting of plants blood; as pricking vines, or other trees, after they be of some growth; and thereby letting forth gum or tears; though this be not to continue, as it is in terebration, but at some seasons. And it is reported, that by this artifice bitter almonds have been turned into sweet.

465. The ancients for the dulcerating of fruit do commend swine's dung above all other dung; which may be because of the moisture of that beast, whereby the excrement hath less acrimony; for we see swines and pigs flesh is the moistest of fleshes.

466. It is observed by some, that all herbs wax sweeter, both in smell and taste, if after they be grown up some reasonable time, they be cut, and so you take the latter sprout. The cause may be, for that the longer the juice stayeth in the root and stalk, the better it concocteth. For one of the chief causes why grains, seeds, and fruits, are more nourishing than leaves, is the length of time in which they grow to maturation. It were not amiss to keep back the sap of herbs, or the like, by some fit means, till the end of summer; whereby, it may be, they will be more nourishing.

467. As grafting doth generally advance and meliorate fruits, above that which they would be if they were set of kernels or stones, in regard the nourishment is better concocted; so, no doubt, even in grafting, for the same cause, the choice of the stock doth much; always provided, that it be somewhat inferior to the cion: for otherwise it dulleth it. They

commend much the grafting of pears or apples upon a quince.

468. Besides the means of melioration of fruits before mentioned, it is set down as tried, that a mixture of bran and swine's dung, or chaff and swine's dung, especially laid up together for a month to rot, is a very great nourisher and comforter to a fruit-tree.

469. It is delivered, that onions wax greater if they be taken out of the earth, and laid a drying twenty days, and then set again; and yet more, if the outermost peel be taken off all over.

470. It is delivered by some, that if one take the bough of a low fruit-tree newly budded, and draw it gently, without hurting it, into an earthen pot perforate at the bottom to let in the plant, and then cover the pot with earth, it will yield a very large fruit within the ground. Which experiment is nothing but potting of plants without removing, and leaving the fruit in the earth. The like, they say, will be effected by an empty pot without earth in it, put over a fruit, being propped up with a stake, as it hangeth upon the tree; and the better if some few pertusions be made in the pot. Wherein, besides the defending of the fruit from extremity of sun or weather, some give a reason, that the fruit loving and coveting the open air and sun, is invited by those pertusions to spread and approach as near the open air as it can; and so enlargeth in magnitude.

471. All trees in high and sandy grounds are to be set deep; and in watery grounds more shallow. And in all trees, when they be removed, especially fruit-trees, care ought to be taken, that the sides of the trees be coasted, north and south, *etc.* as they stood before. The same is said also of stone out of the quarry, to make it more durable; though that seemeth to have less reason; because the stone lieth not so near the sun, as the tree groweth.

472. Timber trees in a coppice wood do grow better than in an open field; both because they offer not to spread so much, but shoot up still in height; and chiefly because they are defended from too much

sun and wind, which do check the growth of all fruit; and so, no doubt, fruit-trees, or vines, set upon a wall against the sun, between elbows or buttresses of stone, ripen more than upon a plain wall.

473. It is said, that if potato-roots be set in a pot filled with earth, and then the pot with earth be set likewise within the ground some two or three inches, the roots will grow greater than ordinary. The cause may be, for that having earth enough within the pot to nourish them; and then being stopped by the bottom of the pot from putting strings downward, they must needs grow greater in breadth and thickness. And it may be, that all seeds or roots potted, and so set into the earth, will prosper the better.

474. The cutting off the leaves of radish, or other roots, in the beginning of winter, before they wither, and covering again the root something high with earth, will preserve the root all winter, and make it bigger in the spring following, as hath been partly touched before. So that there is a double use of this cutting off the leaves; for in plants where the root is the esculent, as radish and parsnips, it will make the root the greater; and so it will do to the heads of onions. And where the fruit is the esculent, by strengthening the root, it will make the fruit also the greater.

475. It is an experiment of great pleasure, to make the leaves of shady trees larger than ordinary. It hath been tried for certain that a cion of a weech-elm, grafted upon the stock of an ordinary elm, will put forth leaves almost as broad as the brim of one's hat. And it is very likely, that as in fruit-trees the graft maketh a greater fruit; so in trees that bear no fruit, it will make the greater leaves. It would be tried therefore in trees of that kind chiefly, as birch, asp, willow; and especially the shining willow, which they call swallow-tail, because of the pleasure of the leaf.

476. The barrenness of trees by accident, besides the weakness of the soil, seed, or root; and the injury of the weather, cometh either of their overgrowing with moss, or their being hide-bound, or their

planting too deep, or by issuing of the sap too much into the leaves. For all these there are remedies mentioned before.

Experiments in consort touching compound fruits and flowers.

We see that in living creatures, that have male and female, there is copulation of several kinds; and so compound creatures; as the mule that is generated betwixt the horse and the ass; and some other compounds which we call monsters, though more rare: and it is held that that proverb, *Africa semper aliquid monstri parit*, cometh, for that the fountains of waters there being rare, divers sorts of beasts come from several parts to drink; and so being refreshed, fall to couple, and many times with several kinds. The compounding or mixture of kinds in plants is not found out; which, nevertheless, if it be possible, is more at command than that of living creatures; for that their lust requireth a voluntary motion; wherefore it were one of the most noble experiments touching plants to find it out: for so you may have great variety of new fruits and flowers yet unknown. Grafting doth it not: that mendeth the fruit, or doubleth the flowers, *etc.* but it hath not the power to make a new kind. For the cion ever over-ruleth the stock.

477. It hath been set down by one of the ancients, that if you take two twigs of several fruit-trees, and flat them on the sides, and then bind them close together and set them in the ground, they will come up in one stock; but yet they will put forth their several fruits without any commixture in the fruit. Wherein note, by the way, that unity of continuance is easier to procure than unity of species. It is reported also, that vines of red and white grapes being set in the ground, and the upper parts being flatted and bound close together, will put forth grapes of the several colours upon the same branch; and grape-stones of several colours within the same grape: but the more after a year or two: the unity, as it seemeth, growing more perfect. And this will likewise help, if from the first uniting

they be often watered; for all moisture helpeth to union. And it is prescribed also to bind the bud as soon as it cometh forth, as well as the stock, at the least for a time.

478. They report, that divers seeds put into a clout, and laid in earth well dunged, will put up plants contiguous; which, afterwards, being bound in, their shoots will incorporate. The like is said of kernels put into a bottle with a narrow mouth filled with earth.

479. It is reported, that young trees of several kinds set contiguous without any binding, and very oft watered, in a fruitful ground, with the very luxury of the trees will incorporate and grow together. Which seemeth to me the likeliest means that hath been propounded; for that the binding doth hinder the natural swelling of the tree; which, while it is in motion, doth better unite.

Experiments in consort touching the sympathy and antipathy of plants.

There are many ancient and received traditions and observations touching the sympathy and antipathy of plants; for that some will thrive best growing near others, which they impute to sympathy; and some worse, which they impute to antipathy. But these are idle and ignorant conceits, and forsake the true indication of the causes, as the most part of experiments that concern sympathies and antipathies do. For as to plants, neither is there any such secret friendship or hatred as they imagine; and if we should be content to call it sympathy and antipathy, it is utterly mistaken; for their sympathy is an antipathy, and their antipathy is a sympathy: for it is thus; Wheresoever one plant draweth such a particular juice out of the earth, as it qualifieth the earth, so as that juice which remaineth is fit for the other plant; there the neighbourhood doth good, because the nourishments are contrary or several: but where two plants draw much the same juice, there the neighbourhood hurteth, for the one deceiveth the other.

480. First therefore, all plants that do draw much nourishment from the earth, and so soak the earth and exhaust it, hurt all things that grow by them; as great trees, especially ashes, and such trees as spread their roots near the top of the ground. So the colewort is not an enemy, though that were anciently received, to the vine only; but it is an enemy to any other plant, because it draweth strongly the fattest juice of the earth. And if it be true, that the vine when it creepeth near the colewort will turn away, this may be, because there it findeth worse nourishment; for though the root be where it was, yet, I doubt, the plant will bend as it nourisheth.

481. Where plants are of several natures, and draw several juices out of the earth, there, as hath been said, the one set by the other helpeth: as it is set down by divers of the ancients, that rue doth prosper much, and becometh stronger, if it be set by a fig-tree; which, we conceive, is caused not by reason of friendship, but by extraction of a contrary juice: the one drawing juice fit to result sweet, the other bitter. So they have set down likewise, that a rose set by garlic is sweeter: which likewise may be, because the more fetid juice of the earth goeth into the garlic, and the more odorate into the rose.

482. This we see manifestly, that there be certain corn flowers which come seldom or never in other places, unless they be set, but only amongst corn; as the blue bottle, a kind of yellow marygold, wild poppy, and fumitory. Neither can this be, by reason of the culture of the ground, by ploughing or furrowing; as some herbs and flowers will grow but in ditches new cast; for if the ground lie fallow and unsown, they will not come: so as it should seem to be the corn that qualifieth the earth, and prepareth it for their growth.

483. This observation, if it holdeth, as it is very probable, is of great use for the meliorating of taste in fruits and esculent herbs, and of the scent of flowers. For I do not doubt, but if the fig-tree do make the rue more strong and bitter, as the ancients

have noted, good store of rue planted about the fig-tree will make the fig more sweet. Now the tastes that do most offend in fruits, and herbs, and roots, are bitter, harsh, sour, and waterish, or flashy. It were good therefore to make the trials following:

484. Take wormwood or rue, and set it near lettuce or coleflory, or artichoke, and see whether the lettuce or the coleflory, *etc.* become not the sweeter.

485. Take a service-tree, or a cornelian tree, or an elder-tree, which we know have fruits of harsh and binding juice, and set them near a vine, or fig-tree, and see whether the grapes or figs will not be the sweeter.

486. Take cucumbers or pumpions, and set them, here and there, amongst musk-melons, and see whether the melons will not be more winy, and better tasted. Set cucumbers, likewise, amongst radish, and see whether the radish will not be made the more biting.

487. Take sorrel, and set it amongst rasps, and see whether the rasps will not be the sweeter.

488. Take common briar, and set it amongst violets or wall-flowers, and see whether it will not make the violets or wall-flowers sweeter, and less earthy in their smell. So set lettuce or cucumbers amongst rosemary or bays, and see whether the rosemary or bays will not be the more oderate or aromatical.

489. Contrariwise, you must take heed how you set herbs together, that draw much the like juice. And therefore I think rosemary will lose in sweetness, if it be set with lavender, or bays, or the like. But yet if you will correct the strength of an herb, you shall do well to set other like herbs by him to take him down; as if you should set tansey by angelica, it may be the angelica would be the weaker, and fitter for mixture in perfume. And if you should set rue by common wormwood, it may be the wormwood would turn to be liker Roman wormwood.

490. This axiom is of large extent; and therefore would be severed and refined by trial. Neither must you expect to have a gross difference by this kind of culture, but only farther perfection.

491. Trial would be also made in herbs poisonous and purgative, whose ill quality, perhaps, may be

discharged, or attempered, by setting stronger poisons or purgatives by them.

492. It is reported, that the shrub called our ladies seal, which is a kind of briony, and coleworts, set near together, one or both will die. The cause is, for that they be both great depredators of the earth, and one of them starveth the other. The like is said of a reed and a brake: both which are succulent; and therefore the one deceiveth the other. And the like of hemlock and rue; both which draw strong juices.

493. Some of the ancients, and likewise divers of the modern writers, that have laboured in natural magic, have noted a sympathy between the sun, moon, and some principal stars, and certain herbs and plants. And so they have denominated some herbs solar, and some lunar; and such like toys put into great words. It is manifest that there are some flowers that have respect to the sun in two kinds, the one by opening and shutting, and the other by bowing and inclining the head. For marygolds, tulips, pimpernel, and indeed most flowers, do open and spread their leaves abroad when the sun shineth serene and fair: and again, in some part, close them, or gather them inward, either towards night, or when the sky is overcast. Of this there needeth no such solemn reason to be assigned; as to say, that they rejoice at the presence of the sun, and mourn at the absence thereof. For it is nothing else but a little loading of the leaves, and swelling them at the bottom, with the moisture of the air; whereas the dry air doth extend them: and they make it a piece of the wonder, that garden clover will hide the stalk when the sun sheweth bright: which is nothing but a full expansion of the leaves. For the bowing and inclining the head, it is found in the great flower of the sun, in marygolds, wartwort, mallow flowers, and others. The cause is somewhat more obscure than the former; but I take it to be no other, but that the part against which the sun beateth waxeth more faint and flaccid in the stalk, and thereby less able to support the flower.

494. What a little moisture will do in vegetables,

even though they be dead and severed from the earth, appeareth well in the experiment of jugglers. They take the beard of an oat; which, if you mark it well, is wreathed at the bottom, and one smooth intire straw at the top. They take only the part that is wreathed, and cut off the other, leaving the beard half the breadth of a finger in length. Then they make a little cross of a quill, longways of that part of the quill which hath the pith; and cross-ways of that piece of the quill without pith; the whole cross being the breadth of a finger high. Then they prick the bottom where the pith is, and thereinto they put the oaten beard, leaving half of it sticking forth of the quill: then they take a little white box of wood, to deceive men, as if somewhat in the box did work the feat; in which, with a pin, they make a little hole, enough to take the beard, but not to let the cross sink down, but to stick. Then likewise, by way of imposture, they make a question; as, Who is the fairest woman in the company? or, Who hath a glove or card? and cause another to name divers persons: and upon every naming they stick the cross in the box, having first put it towards their mouth, as if they charmed it; and the cross stirreth not; but when they come to the person that they would take, as they hold the cross to their mouth, they touch the beard with the tip of their tongue, and wet it; and so stick the cross in the box; and then you shall see it turn finely and softly three or four turns; which is caused by the untwining of the beard by the moisture. You may see it more evidently, if you stick the cross between your fingers instead of the box; and therefore you may see, that this motion, which is effected by so little wet, is stronger than the closing or bending of the head of a marygold.

495. It is reported by some, that the herb called *rosa solis*, whereof they make strong waters, will, at the noon-day when the sun shineth hot and bright, have a great dew upon it. And therefore that the right name is *ros solis:* which they impute to a delight and sympathy that it hath with the sun. Men favour wonders. It were good first to be sure, that

the dew that is found upon it, be not the dew of the morning preserved, when the dew of other herbs is breathed away; for it hath a smooth and thick leaf, that doth not discharge the dew so soon as other herbs that are more spungy and porous. And it may be purslane, or some other herb, doth the like, and is not marked. But if it be so, that it hath more dew at noon than in the morning, then sure it seemeth to be an exudation of the herb itself. As plums sweat when they are set into the oven: for you will not, I hope, think, that it is like Gideon's fleece of wool, that the dew should fall upon that and no where else.

496. It is certain, that the honey dews are found more upon oak leaves, than upon ash, or beech, or the like: but whether any cause be from the leaf itself to concoct the dew; or whether it be only that the leaf is close and smooth, and therefore drinketh not in the dew, but preserveth it, may be doubted. It would be well enquired, whether manna the drug doth fall but upon certain herbs or leaves only. Flowers that have deep sockets, do gather in the bottom a kind of honey; as honey-suckles, both the woodbine and the trefoil, lilies, and the like. And in them certainly the flower beareth part with the dew.

497. The experience is, that the froth which they call woodseare, being like a kind of spittle, is found but upon certain herbs, and those hot ones; as lavender, lavender-cotton, sage, hyssop, *etc.* Of the cause of this inquire farther; for it seemeth a secret. There falleth also mildew upon corn, and smutteth it; but it may be, that the same falleth also upon other herbs, and is not observed.

498. It were good trial were made, whether the great consent between plants and water, which is a principal nourishment of them, will make an attraction at distance, and not at touch only. Therefore take a vessel, and in the middle of it make a false bottom of coarse canvas: fill it with earth above the canvas, and let not the earth be watered; then sow some good seeds in that earth; but under the canvas, some half a foot in the bottom of the vessel, lay a great spunge thoroughly wet in water; and let it lie

so some ten days, and see whether the seeds will sprout, and the earth become more moist, and the spunge more dry. The experiment formerly mentioned of the cucumber creeping to the pot of water, is far stranger than this.

Experiments in consort touching the making herbs and fruits medicinable.

499. The altering of the scent, colour, or taste of fruit, by infusing, mixing, or letting into the bark, or root of the tree, herb, or flower, any coloured, aromatical, or medicinal substance, are but fancies. The cause is, for that those things have passed their period, and nourish not. And all alteration of vegetables in those qualities must be by somewhat that is apt to go into the nourishment of the plant. But this is true, that where kine feed upon wild garlick, their milk tasteth plainly of the garlic: and the flesh of muttons is better tasted where the sheep feed upon wild thyme, and other wholesome herbs. Galen also speaketh of the curing of the *scirrus* of the liver, by milk of a cow that feedeth but upon certain herbs; and honey in Spain smelleth apparently of the rosemary or orange, from whence the bee gathereth it: and there is an old tradition of a maiden that was fed with *napellus*; which is counted the strongest poison of all vegetables, which with use did not hurt the maid, but poisoned some that had carnal company with her. So it is obverved by some, that there is a virtuous bezoar, and another without virtue, which appear to the shew alike: but the virtuous is taken from the beast that feedeth upon the mountains, where there are theriacal herbs; and that without virtue, from those that feed in the vallies where no such herbs are. Thus far I am of opinion; that as steeped wines and beers are very medicinal; and likewise bread tempered with divers powders; so of meat also, as flesh, fish, milk, and eggs, that they may be made of great use for medicine and diet, if the beasts, fowl, or fish, be fed with a special kind of food fit for the disease. It were a dangerous thing also for secret empoisonments. But whether it may be applied unto plants

and herbs, I doubt more; because the nourishment of them is a more common juice; which is hardly capable of any special quality, until the plant do assimilate it.

500. But lest our incredulity may prejudice any profitable operations in this kind, especially since many of the ancients have set them down, we think good briefly to propound the four means which they have devised of making plants medicinable. The first is by slitting of the root, and infusing into it the medicine; as hellebore, opium, scammony, treacle, *etc.* and then binding it up again. This seemeth to me the least probable; because the root draweth immediately from the earth; and so the nourishment is the more common and less qualified: and besides, it is a long time in going up ere it come to the fruit. The second way is to perforate the body of the tree, and there to infuse the medicine; which is somewhat better: for if any virtue be received from the medicine, it hath the less way, and the less time to go up. The third is, the steeping of the seed or kernel in some liquor wherein the medicine is infused: which I have little opinion of, because the seed, I doubt, will not draw the parts of the matter which have the propriety: but it will be far the more likely, if you mingle the medicine with dung; for that the seed naturally drawing the moisture of the dung, may call in withal some of the propriety. The fourth is, the watering of the plant oft with an infusion of the medicine. This, in one respect may have more force than the rest, because the medication is oft renewed; whereas the rest are applied but at one time; and therefore the virtue may the sooner vanish. But still I doubt, that the root is somewhat too stubborn to receive those fine impressions; and besides, as I said before, they have a great hill to go up. I judge therefore the likeliest way to be the perforation of the body of the tree in several places one above the other; and the filling of the holes with dung mingled with the medicine; and the watering of those lumps of dung with squirts of an infusion of the medicine in dunged water, once in three or four days.

NATURAL HISTORY.

CENTURY VI.

Experiments in consort touching curiosities about fruits and plants.

OUR experiments we take care to be, as we have often said, either *experimenta fructifera*, or *lucifera*; either of use, or of discovery: for we hate impostures, and despise curiosities. Yet because we must apply ourselves somewhat to others, we will set down some curiosities touching plants.

501. IT is a curiosity to have several fruits upon one tree; and the more when some of them come early, and some come late; so that you may have upon the same tree ripe fruits all summer. This is easily done by grafting of several cions upon several boughs, of a stock, in a good ground plentifully fed. So you may have all kinds of cherries, and all kinds of plums, and peaches, and apricots, upon one tree; but I conceive the diversity of fruits must be such as will graft upon the same stock. And therefore I doubt, whether you can have apples, or pears, or oranges, upon the same stock upon which you graft plums.

502. IT is a curiosity to have fruits of divers shapes and figures. This is easily performed, by molding them when the fruit is young, with molds of earth or wood. So you may have cucumbers, *&c.* as long as a cane; or as round as a sphere; or formed like a cross. You may have also apples in the form of pears or lemons. You may have also fruit in more accurate figures, as we said of men, beasts, or birds, according as you make the molds. Wherein you must understand, that you make the mold big enough to contain the whole fruit when it is grown to the greatest: for else you will choke the spreading of

the fruit; which otherwise would spread itself, and fill the concave, and so be turned into the shape desired; as it is in mold works of liquid things. Some doubt may be conceived, that the keeping of the sun from the fruit may hurt it: but there is ordinary experience of fruit that groweth covered. *Query*, also, whether some small holes may not be made in the wood to let in the sun. And note, that it were best to make the molds partible, glued, or cemented together, that you may open them when you take out the fruit.

503. It is a curiosity to have inscriptions, or engravings, in fruit or trees. This is easily performed, by writing with a needle, or bodkin, or knife, or the like, when the fruit or trees are young; for as they grow, so the letters will grow more large and graphical

—Tenerisque meos incidere amores
Arboribus; crescent illæ, crescetis amores.

504. You may have trees appareled with flowers or herbs, by boring holes in the bodies of them, and putting into them earth holpen with muck, and setting seeds, or slips, of violets, strawberries, wild thyme, camomile, and such like, in the earth. Wherein they do but grow in the tree as they do in pots; though, perhaps, with some feeding from the trees. It would be tried also with shoots of vines, and roots of red roses,; for it may be they being of a more ligneous nature, will incorporate with the tree itself.

505. It is an ordinary curiosity to form trees and shrubs, as rosemary, juniper, and the like, into sundry shapes; which is done by molding them within, and cutting them without. But they are but lame things, being too small to keep figure: great castles made of trees upon frames of timber, with turrets and arches, were matters of magnificence.

506. Amongst curiosities I shall place coloration, though it be somewhat better: for beauty in flowers is their preeminence. It is observed by some, that gilly-flowers, sweet-williams, violets, that are coloured, if they be neglected, and neither watered, nor

new molded, nor transplanted, will turn white. And it is probable that the white with much culture may turn coloured. For this is certain, that the white colour cometh of scarcity of nourishment; except in flowers that are only white, and admit no other colours.

507. It is good therefore to see what natures do accompany what colours; for by that you shall have light how to induce colours, by producing those natures. Whites are more inodorate, for the most part, than flowers of the same kind coloured; as is found in single white violets, white roses, white gilly-flowers, white stock-gilly-flowers, *etc.* We find also that blossoms of trees, that are white, are commonly inodorate, as cherries, pears, plums; whereas those of apples, crabs, almonds, and peaches, are blushy and smell sweet. The cause is, for that the substance that maketh the flower is of the thinnest and finest of the plant, which also maketh flowers to be of so dainty colours. And if it be too sparing and thin, it attaineth no strength of odour, except it be in such plants as are very succulent; whereby they need rather to be scanted in their nourishment than replenished, to have them sweet. As we see in white satyrion, which is of a dainty smell; and in bean-flowers, *etc.* And again, if the plant be of nature to put forth white flowers only, and those not thin or dry, they are commonly of rank and fulsome smell; as may-flowers, and white lilies.

508. Contrariwise, in berries the white is commonly more delicate and sweet in taste than the coloured, as we see in white grapes, in white rasps, in white strawberries, in white currants, &c. The cause is, for that the coloured are more juiced, and coarser juiced, and therefore not so well and equally concocted; but the white are better proportioned to the digestion of the plant.

509. But in fruits the white commonly is meaner: as in pear-plums, damascenes, *etc.* and the choicest plums are black; the mulberry, which though they call it a berry, is a fruit, is better the black than the

white. The harvest white plum is a base plum; and the verdoccio, and white date-plum, are no very good plums. The cause is, for that they are all over-watery; whereas an higher concoction is required for sweetness, or pleasure of taste; and therefore all your dainty plums are a little dry, and come from the stone; as the muscle-plum, the damascene plum, the peach, the apricot, *etc.* yet some fruits, which grow not to be black, are of the nature of berries, sweetest such as are paler; as the cœur-cherry, which inclineth more to white, is sweeter than the red; but the egriot is more sour.

510. Take gilly-flower seed, of one kind of gilly-flower, as of the clove-gilly-flower, which is the most common, and sow it, and there will come up gilly-flowers, some of one colour, and some of another, casually, as the seed meeteth with nourishment in the earth; so that the gardeners find, that they may have two or three roots amongst an hundred that are rare and of great price; as purple, carnation of several stripes: the cause is, no doubt, that in earth, though it be contiguous, and in one bed, there are very several juices; and as the seed doth casually meet with them, so it cometh forth. And it is noted especially, that those which do come up purple, do always come up single: the juice, as it seemeth, not being able to suffice a succulent colour, and a double leaf. This experiment of several colours coming up from one seed, would be tried also in larks-foot, monks-hood, poppy, and holyoak.

511. Few fruits are coloured red within; the queen-apple is; and another apple, called the rose-apple: mulberries, likewise, and grapes, though most toward the skin. There is a peach also that hath a circle of red towards the stone: and the egriot cherry is somewhat red within; but no pear, nor warden, nor plum, nor apricot, although they have many times red sides, are coloured red within. The cause may be inquired.

512. The general colour of plants is green, which is a colour that no flower is of. There is a greenish

primrose, but it is pale and scarce a green. The leaves of some trees turn a little murry or reddish; and they be commonly young leaves that do so; as it is in oaks, and vines, and hazle. Leaves rot into a yellow, and some hollies have part of their leaves yellow, and are, to all seeming, as fresh and shining as the green. I suppose also, that yellow is a less succulent colour than green, and a degree nearer white. For it hath been noted, that those yellow leaves of holly stand ever towards the north or north-east. Some roots are yellow, as carrots; and some plants blood-red, stalk and leaf, and all, as amaranthus. Some herbs incline to purple and red; as a kind of sage doth, and a kind of mint, and *rosa solis*, *etc.* And some have white leaves, as another kind of sage, and another kind of mint; but azure and a fair purple are never found in leaves. This sheweth, that flowers are made of a refined juice of the earth, and so are fruits; but leaves of a more coarse and common.

513. It is a curiosity also to make flowers double, which is effected by often removing them into new earth; as, on the contrary part, double flowers, by neglecting and not removing, prove single. And the way to do it speedily, is to sow or set seeds or slips of flowers; and as soon as they come up, to remove them into new ground that is good. Inquire also, whether inoculating of flowers, as stock-gilly-flowers, roses, musk-roses, *etc.* doth not make them double. There is a cherry-tree that hath double blossoms; but that tree beareth no fruit: and it may be, that the same means which, applied to the tree, doth extremely accelerate the sap to rise and break forth, would make the tree spend itself in flowers, and those to become double: which were a great pleasure to see, especially in apple-trees, peach-trees, and almond-trees, that have blossoms blush-coloured.

514. The making of fruits without core or stone, is likewise a curiosity, and somewhat better: because whatsoever maketh them so, is like to make them more tender and delicate. If a cion or shoot, fit to be set in the ground, have the pith finely taken forth, and

not altogether, but some of it left, the better to save the life, it will bear a fruit with little or no core or stone. And the like is said to be of dividing a quick tree down to the ground, and taking out the pith, and then binding it up again.

515. It is reported also, that a citron grafted upon a quince will have small or no seeds; and it is very probable that any sour fruit grafted upon a stock that beareth a sweeter fruit, may both make the fruit sweeter, and more void of the harsh matter of kernels or seeds.

516. It is reported, that not only the taking out of the pith, but the stopping of the juice of the pith from rising in the midst, and turning it to rise on the outside, will make the fruit without core or stone; as if you should bore a tree clean through, and put a wedge in. It is true, there is some affinity between the pith and the kernel, because they are both of a harsh substance, and both placed in the midst.

517. It is reported, that trees watered perpetually with warm water, will make a fruit with little or no core or stone. And the rule is general, that whatsoever will make a wild tree a garden tree, will make a a garden tree to have less core or stone.

Experiments in consort touching the degenerating of plants, and of the transmutation of them one into another.

518. The rule is certain, that plants for want of culture degenerate to be baser in the same kind; and sometimes so far, as to change into another kind. 1. The standing long, and not being removed, maketh them degenerate. 2. Drought, unless the earth of itself be moist, doth the like. 3. So doth removing into worse earth, or forbearing to compost the earth; as we see that water-mint turneth into field mint, and the colewort into rape, by neglect, *etc.*

519. Whatsoever fruit useth to be set upon a root or a slip, if it be sown, will degenerate. Grapes sown, figs, almonds, pomegranate kernels sown, make the fruits degenerate and become wild. And again,

most of those fruits that use to be grafted, if they be set of kernels, or stones, degenerate. It is true that peaches, as hath been touched before, do better upon stones set than upon grafting: and the rule of exception should seem to be this: that whatsoever plant requireth much moisture, prospereth better upon the stone or kernel than upon the graft. For the stock, though it giveth a finer nourishment, yet it giveth a scantier than the earth at large.

520. Seeds, if they be very old, and yet have strength enough to bring forth a plant, make the plant degenerate. And therefore skilful gardeners make trial of the seeds before they buy them, whether they be good or no, by putting them into water gently boiled; and if they be good, they will sprout within half an hour.

521. It is strange which is reported, that basil too much exposed to the sun doth turn unto wild thyme; although those two herbs seem to have small affinity; but basil is almost the only hot herb that hath fat and succulent leaves; which oiliness, if it be drawn forth by the sun, it is like it will make a very great change.

522. There is an old tradition, that boughs of oak put into the earth will put forth wild vines: which if it be true, no doubt it is not the oak that turneth into a vine, but the oak-bough putrifying, qualifieth the earth to put forth a vine of itself.

523. It is not impossible, and I have heard it verified, that upon cutting down of an old timber tree, the stub hath put out sometimes a tree of another kind; as that beech hath put forth birch; which, if it be true, the cause may be, for that the old stub is too scanty of juice to put forth the former tree; and therefore putteth forth a tree of a smaller kind, that needeth less nourishment.

524. There is an opinion in the country, that if the same ground be oft sown with the grain that grew upon it, it will in the end grow to be of a baser kind.

525. It is certain, that in very steril years corn sown will grow to another kind.

Grandia sæpe quibus mandavimus hordea sulcis,
Infelix lolium, et steriles dominantur avenæ.

And generally it is a rule, that plants that are brought forth by culture, as corn, will sooner change into other species, than those that come of themselves; for that culture giveth but an adventitious nature, which is more easily put off.

This work of the transmutation of plants one into another, is *inter magnalia naturæ*; for the transmutation of species is, in the vulgar philosophy, pronounced impossible: and certainly it is a thing of difficulty, and requireth deep search into nature; but seeing there appear some manifest instances of it, the opinion of impossibility is to be rejected, and the means thereof to be found out. We see, that in living creatures, that come of putrefaction, there is much transmutation of one into another; as caterpillars turn into flies, *etc.* And it should seem probable, that whatsoever creature, having life, is generated without seed, that creature will change out of one species into another. For it is the seed and the nature of it, which locketh and boundeth in the creature, that it doth not expatiate. So as we may well conclude, that seeing the earth of itself doth put forth plants without seed, therefore plants may well have a transmigration of species. Wherefore, wanting instances which do occur, we shall give directions of the most likely trials; and generally we would not have those that read this our work of *Sylva sylvarum* account it strange, or think that it is an over-haste, that we have set down particulars untried; for contrariwise, in our own estimation we account such particulars more worthy than those that are already tried and known: for these latter must be taken as you find them; but the other do level point-blank at the inventing of causes and axioms.

526. First therefore, you must make an account that if you will have one plant change into another, you must have the nourishment over-rule the seed; and therefore you are to practise it by nourishments as contrary as may be to the nature of the herb, so ne-

vertheless as the herb may grow; and likewise with seeds that are of the weakest sort, and have least vigour. You shall do well, therefore, to take marsh-herbs, and plant them upon tops of hills and champaigns; and such plants as require much moisture upon sandy and very dry grounds. As for example, marsh-mallows and sedge, upon hills; cucumber, and lettuce seeds, and coleworts, upon a sandy plot; so contrariwise, plant bushes, heath, ling, and brakes, upon a wet or marsh ground. This I conceive also, that all esculent and garden herbs, set upon the tops of hills, will prove more medicinal, though less esculent than they were before. And it may be likewise, some wild herbs you may make sallad herbs. This is the first rule for transmutation of plants.

527. The second rule shall be, to bury some few seeds of the herb you would change, amongst other seeds; and then you shall see, whether the juice of those other seeds do not so qualify the earth, as it will alter the seed whereupon you work. As for example, put parsley seed amongst onion seed, or lettuce seed amongst parsley seed, or basil seed amongst thyme seed; and see the change of taste or otherwise. But you shall do well to put the seed you would change into a little linen cloth, that it mingle not with the foreign seed.

528. The third rule shall be, the making of some medley or mixture of earth with some other plants bruised or shaven either in leaf or root: as for example, make earth with a mixture of colewort leaves stamped, and set in it artichokes or parsnips; so take earth made with marjoram, or origanum, or wild thyme, bruised or stamped, and set in it fennel seed, *etc.* In which operation the process of nature still will be, as I conceive, not that the herb you work upon should draw the juice of the foreign herb, for that opinion we have formerly rejected, but that there will be a new confection of mold, which perhaps will alter the seed, and yet not to the kind of the former herb.

529. The fourth rule shall be, to mark what herbs

some earths do put forth of themselves; and to take that earth, and to pot it, or to vessel it; and in that to set the seed you would change: as for example, take from under walls or the like, where nettles put forth in abundance, the earth which you shall there find, without any string or root of the nettles; and pot that earth, and set in it stock-gilly-flowers, or wall-flowers, *etc.* or sow in the seeds of them; and see what the event will be: or take earth that you have prepared to put forth mushrooms of itself, whereof you shall find some instances following, and sow in it purslane seed, or lettuce seed; for in these experiments, it is likely enough that the earth being accustomed to send forth one kind of nourishment, will alter the new seed.

530. The fifth rule shall be, to make the herb grow contrary to its nature; as to make ground-herbs rise in height: as for example, carry camomile, or wild thyme, or the green strawberry, upon sticks, as you do hops upon poles; and see what the event will be.

531. The sixth rule shall be, to make plants grow out of the sun or open air; for that is a great mutation in nature, and may induce a change in the seed: as barrel up earth, and sow some seed in it, and put it in the bottom of a pond; or put it in some great hollow tree; try also the sowing of seeds in the bottoms of caves; and pots with seeds sown, hanged up in wells some distance from the water, and see what the event will be.

Experiments in consort touching the procerity, and lowness, and artificial dwarfing of trees.

532. It is certain, that timber trees in coppice woods grow more upright, and more free from underboughs, than those that stand in the fields: the cause whereof is, for that plants have a natural motion to get to the sun; and besides, they are not glutted with too much nourishment; for that the coppice shareth with them; and repletion ever hindereth stature: lastly, they are kept warm; and that ever in plants helpeth mounting.

533. Trees that are of themselves full of heat, which heat appeareth by their inflammable gums, as firs and pines, mount of themselves in height without side-boughs, till they come towards the top. The cause is partly heat, and partly tenuity of juice, both which send the sap upwards. As for juniper, it is but a shrub, and groweth not big enough in body to maintain a tall tree.

534. It is reported, that a good strong canvass, spread over a tree grafted low, soon after it putteth forth, will dwarf it, and make it spread. The cause is plain; for that all things that grow, will grow as they find room.

535. Trees are generally set of roots or kernels; but if you set them of slips, as of some trees you may, by name the mulberry, some of the slips will take; and those that take, as is reported, will be dwarf trees. The cause is, for that a slip draweth nourishment more weakly than either a root or kernel.

536. All plants that put forth their sap hastily, have their bodies not proportionable to their length; and therefore they are winders and creepers; as ivy, briony, hops, woodbine: whereas dwarfing requireth a slow putting forth, and less vigour of mounting.

Experiments in consort touching the rudiments of plants, and of the excrescences of plants, or super-plants.

The Scripture saith, that Solomon wrote a Natural History, *from the cedar of Libanus, to the moss growing upon the wall:* for so the best translations have it. And it is true that moss is but the rudiment of a plant; and, as it were, the mold of earth or bark.

537. Moss groweth chiefly upon ridges of houses, tiled or thatched, and upon the crests of walls: and that moss is of a lightsome and pleasant green. The growing upon slopes is caused, for that moss, as on the one side it cometh of moisture and water, so on the other side the water must but slide, and not stand or pool. And the growing upon tiles, or walls, *etc.* is caused, for that those dried earths, having not moisture

sufficient to put forth a plant, do practise germination by putting forth moss; though when, by age or otherwise, they grow to relent and resolve, they sometimes put forth plants, as wall-flowers. And almost all moss hath here and there little stalks, besides the low thrum.

538. Moss groweth upon alleys, especially such as lie cold and upon the north; as in divers terrasses: and again, if they be much trodden; or if they were at the first gravelled; for wheresoever plants are kept down, the earth putteth forth moss.

539. Old ground, that hath been long unbroken up, gathereth moss: and therefore husbandmen use to cure their pasture grounds when they grow to moss, by tilling them for a year or two: which also dependeth upon the same cause; for that the more sparing and starving juice of the earth, insufficient for plants, doth breed moss.

540. Old trees are more mossy far than young; for that the sap is not so frank as to rise all to the boughs, but tireth by the way, and putteth out moss.

541. Fountains have moss growing upon the ground about them;

Muscosi fontes;

The cause is, for that the fountains drain the water from the ground adjacent, and leave but sufficient moisture to breed moss: and besides, the coldness of the water conduceth to the same.

542. The moss of trees is a kind of hair; for it is the juice of the tree that is excerned, and doth not assimilate. And upon great trees the moss gathereth a figure like a leaf.

543. The moister sort of trees yield little moss; as we see in asps, poplars, willows, beeches, *etc.* which is partly caused for the reason that hath been given, of the frank putting up of the sap into the boughs; and partly for that the barks of those trees are more close and smooth than those of oaks and ashes; whereby the moss can the hardlier issue out.

544. In clay-grounds all fruit-trees grow full of moss, both upon body and boughs; which is caused

partly by the coldness of the ground, whereby the plants nourish less; and partly by the toughness of the earth, whereby the sap is shut in, and cannot get up to spread so frankly as it should do.

545. We have said heretofore, that if trees be hide-bound, they wax less fruitful, and gather moss; and that they are holpen by hacking, *etc.* And therefore, by the reason of contraries, if trees be bound in with cords, or some outward bands, they will put forth more moss: which, I think, happeneth to trees that stand bleak, and upon the cold winds. It should also be tried, whether, if you cover a tree somewhat thick upon the top after his polling, it will not gather more moss. I think also the watering of trees with cold fountain-water, will make them grow full of moss.

546. There is a moss the perfumers have, which cometh out of apple trees, that hath an excellent scent. *Query*, particularly for the manner of the growth, and the nature of it. And for this experiment's sake, being a thing of price, I have set down the last experiments how to multiply and call on mosses.

Next unto moss, I will speak of mushrooms; which are likewise an imperfect plant. The mushrooms have two strange properties; the one, that they yield so delicious a meat; the other, that they come up so hastily, as in a night; and yet they are unsown. And therefore such as are upstarts in state, they call in reproach mushrooms. It must needs be therefore, that they be made of much moisture; and that moisture fat, gross, and yet somewhat concocted. And, indeed, we find that mushrooms cause the accident which we call *incubus*, or the mare in the stomach. And therefore the surfeit of them may suffocate and empoison. And this sheweth that they are windy; and that windiness is gross and swelling, not sharp or griping. And upon the same reason mushrooms are a venereous meat.

547. It is reported, that the bark of white or red poplar, which are of the moistest of trees, cut small, and cast into furrows well dunged, will cause the

ground to put forth mushrooms at all seasons of the year fit to be eaten. Some add to the mixture leaven of bread dissolved in water.

548. It is reported, that if a hilly field, where the stubble is standing, be set on fire in a showery season, it will put forth great store of mushrooms.

549. It is reported, that hartshorn, shaven, or in small pieces, mixed with dung and watered, putteth up mushrooms. And we know hartshorn is of a fat and clammy substance: and it may be ox-horn would do the like.

550. It hath been reported, though it be scarce credible, that ivy hath grown out of a stag's horn; which they suppose did rather come from a confrication of the horn upon the ivy, than from the horn itself. There is not known any substance but earth, and the procedures of earth, as tile, stone, *etc.* that yieldeth any moss or herby substance. There may be trial made of some seeds, as that of fennel seed, mustard-seed, and rape-seed, put into some little holes made in the horns of stags, or oxen, to see if they will grow.

551. There is also another imperfect plant, that in shew is like a great mushroom: and it is sometimes as broad as one's hat; which they call a toad's stool; but it is not esculent; and it groweth, commonly, by a dead stub of a tree, and likewise about the roots of rotten trees: and therefore seemeth to take his juice from wood putrified. Which sheweth, by the way, that wood putrified, yieldeth a frank moisture.

552. There is a cake that groweth upon the side of a dead tree, that hath gotten no name, but it is large, and of a chesnut colour, and hard and pithy; whereby it should seem, that even dead trees forget not their putting forth; no more than the carcases of mens bodies, that put forth hair and nails for a time.

553. There is a cod, or bag, that groweth commonly in the fields; that at the first is hard like a tennis-ball, and white; and after groweth of a mushroom colour, and full of light dust upon the breaking; and is thought to be dangerous for the eyes if the

powder get into them; and to be good for kibes. Belike it hath a corrosive and fretting nature.

554. There is an herb called Jews-ear, that groweth upon the roots and lower parts of the bodies of trees; especially of elders, and sometimes ashes. It hath a strange property; for in warm water it swelleth, and openeth extremely. It is not green, but of a dusky brown colour. And it is used for squinancies and inflammations in the throat; whereby it seemeth to have a mollifying and lenifying virtue.

555. There is a kind of spungy excrescence, which groweth chiefly upon the roots of the laser-tree; and sometimes upon cedar and other trees. It is very white, and light, and friable; which we call agaric. It is famous in physic for the purging of tough phlegm. And it is also an excellent opener for the liver; but offensive to the stomach: and in taste, it is at the first sweet, and after bitter.

556. We find no super-plant that is a formed plant, but misseltoe. They have an idle tradition, that there is a bird called a missel bird, that feedeth upon a seed, which many times she cannot digest, and so expelleth it whole with her excrement: which falling upon the bough of a tree that hath some rift, putteth forth the misseltoe. But this is a fable; for it is not probable that birds should feed upon what they cannot digest. But allow that, yet it cannot be for other reasons: for first it is found but upon certain trees; and those trees bear no such fruit, as may allure that bird to sit and feed upon them. It may be, that bird feedeth upon the misseltoe-berries, and so is often found there; which may have given occasion to the tale. But that which maketh an end of the question is, that misseltoe hath been found to put forth under the boughs, and not only above the boughs; so it cannot be any thing that falleth upon the bough. Misseltoe groweth chiefly upon crab-trees, appletrees, sometimes upon hazles, and rarely upon oaks; the misseltoe whereof is counted very medicinal. It is ever green winter and summer; and beareth a white glistering berry: and it is a plant utterly differing

from the plant upon which it groweth. Two things therefore may be certainly set down: first, that superfœtation must be by abundance of sap in the bough that putteth it forth: secondly, that that sap must be such as the tree doth excern, and cannot assimilate; for else it would go into a bough; and besides, it seemeth to be more fat and unctuous than the ordinary sap of the tree; both by the berry, which is clammy; and by that it continueth green winter and summer, which the tree doth not.

557. This experiment of misseltoe may give light to other practices. Therefore trial should be made by ripping of the bough of a crab-tree in the bark; and watering of the wound every day with warm water dunged, to see if it would bring forth misseltoe, or any such like thing. But it were yet more likely to try it with some other watering or anointing, that were not so natural to the tree as water is; as oil, or barm of drink, *etc.* so they be such things as kill not the bough.

558. It were good to try, what plants would put forth, if they be forbidden to put forth their natural boughs: poll therefore a tree, and cover it some thickness with clay on the top, and see what it will put forth. I suppose it will put forth roots; for so will a cion, being turned down into clay: therefore, in this experiment also, the tree should be closed with somewhat that is not so natural to the plant as clay is. Try it with leather, or cloth, or painting, so it be not hurtful to the tree. And it is certain, that a brake hath been known to grow out of a pollard.

559. A man may count the prickles of trees to be a kind of excrescence; for they will never be boughs, nor bear leaves. The plants that have prickles are thorns, black and white; brier, rose, lemon-trees, crab-trees, gooseberry, berberry; these have it in the bough: the plants that have prickles in the leaf are, holly, juniper, whin-bush, thistle; nettles also have a small venomous prickle; so hath borage, but harmless. The cause must be hasty putting forth, want of moisture, and the closeness of the bark; for the

haste of the spirit to put forth, and the want of nourishment to put forth a bough, and the closeness of the bark, cause prickles in boughs; and therefore they are ever like a *pyramis*, for that the moisture spendeth after a little putting forth. And for prickles in leaves, they come also of putting forth more juice into the leaf than can spread in the leaf smooth, and therefore the leaves otherwise are rough as borage and nettles are. As for the leaves of holly, they are smooth, but never plain, but as it were with folds, for the same cause.

560. There be also plants, that though they have no prickles, yet they have a kind of downy or velvet rind upon their leaves; as rose-campion, stock-gilly-flowers, colt's-foot; which down or knap cometh of a subtil spirit, in a soft or fat substance. For it is certain, that both stock-gilly-flowers and rose campions, stamped, have been applied with success to the wrists of those that have had tertian and quartan agues; and the vapour of colt's-foot hath a sanative virtue towards the lungs; and the leaf also is healing in surgery.

561. Another kind of excrescence is an exudation of plants joined with putrefaction; as we see in oak-apples, which are found chiefly upon theleaves of oaks, and the like upon willows: and country people have a kind of prediction, that if the oak-apple broken be full of worms, it is a sign of a pestilent year; which is a likely thing, because they grow of corruption.

562. There is also upon sweet, or other brier, a fine tuft or brush of moss of divers colours; which if you cut you shall ever find full of little white worms.

Experiments in consort touching the producing of perfect plants without seed.

563. It is certain, that earth taken out of the foundations of vaults and houses, and bottoms of wells, and then put into pots, will put forth sundry kinds of herbs: but some time is required for the germination: for if it be taken but from a fathom deep, it will put forth the first year; if much deeper, not till after a year or two.

564. The nature of the plants growing out of earth so taken up, doth follow the nature of the mold itself; as if the mold be soft and fine, it putteth forth soft herbs; as grass, plantain, and the like; if the earth be harder and coarser, it putteth forth herbs more rough, as thistles, firs, *etc.*

565. It is common experience, that where alleys are close gravelled, the earth putteth forth the first year knot grass, and after spire grass. The cause is, for that the hard gravel or pebble at the first laying will not suffer the grass to come forth upright, but turneth it to find his way where it can; but after that the earth is somewhat loosened at the top, the ordinary grass cometh up.

566. It is reported, that earth being taken out of shady and watery woods some depth, and potted, will put forth herbs of a fat and juicy substance; as penny-wort, purslane, housleek, penny-royal, *etc.*

567. The water also doth send forth plants that have no roots fixed in the bottom; but they are less perfect plants, being almost but leaves, and those small ones; such is that we call duckweed, which hath a leaf no bigger than a thyme leaf, but of a fresher green, and putteth forth a little string into the water far from the bottom. As for the water lily, it hath a root in the ground; and so have a number of other herbs that grow in ponds.

568. It is reported by some of the ancients, and some modern testimony likewise, that there be some plants that grow upon the top of the sea, being supposed to grow of some concretion of slime from the water, where the sun beateth hot, and where the sea stirreth little. As for *alga marina*, sea weed, and *eryngium*, sea thistle, both have roots; but the sea weed under the water, the sea thistle but upon the shore.

569. The ancients have noted, that there are some herbs that grow out of snow laid up close together and putrified, and that they are all bitter; and they name one specially, *flomus*, which we call moth-mullein. It is certain, that worms are found in snow

commonly, like earth-worms; and therefore it is not unlike, that it may likewise put forth plants.

570. The ancients have affirmed, that there are some herbs that grow out of stone; which may be, for that it is certain that toads have been found in the middle of a free-stone. We see also that flints, lying above ground, gather moss; and wall-flowers, and some other flowers, grow upon walls; but whether upon the main brick or stone, or whether out of the lime or chinks, is not well observed: for alders and ashes have been seen to grow out of steeples; but they manifestly grow out of clefts; insomuch as when they grow big, they will disjoin the stone. And besides, it is doubtful whether the mortar itself putteth it forth, or whether some seeds be not let fall by birds. There be likewise rock-herbs; but I suppose those are where there is some mold or earth. It hath likewise been found, that great trees growing upon quarries have put down their root into the stone.

571. In some mines in Germany, as is reported, there grow in the bottom vegetables; and the work folks used to say they have magical virtue, and will not suffer men to gather them.

572. The sea sands seldom bear plants. Whereof the cause is yielded by some of the ancients, for that the sun exhaleth the moisture before it can incorporate with the earth, and yield a nourishment for the plant. And it is affirmed also, that sand hath always its root in clay; and that there be no veins of sand any great depth within the earth.

573. It is certain, that some plants put forth for a time of their own store, without any nourishment from earth, water, stone, *etc.* of which *vide* the experiment 29.

Experiments in consort touching foreign plants.

574. It is reported, that earth that was brought out of the Indies and other remote countries for ballast of ships, cast upon some grounds in Italy, did put forth foreign herbs, to us in Europe not known; and that which is more, that of their roots, barks,

and seeds, contused together, and mingled with other earth, and well watered with warm water, there came forth herbs much like the other.

575. Plants brought out of hot countries will endeavour to put forth at the same time that they usually do in their own climate; and therefore to preserve them, there is no more required, than to keep them from the injury of putting back by cold. It is reported also, that grain out of the hotter countries translated into the colder, will be more forward than the ordinary grain of the cold country. It is likely that this will prove better in grains than in trees, for that grains are but annual, and so the virtue of the seed is not worn out; whereas in a tree, it is embased by the ground to which it is removed.

576. Many plants which grow in the hotter countries, being set in the colder, will nevertheless, even in those cold countries, being sown of seeds late in the spring, come up and abide most part of the summer; as we find it in orange and lemon seeds, *etc.* the seeds whereof sown in the end of April will bring forth excellent sallads, mingled with other herbs. And I doubt not, but the seeds of clove-trees, and pepper seeds, *etc.* if they could come hither green enough to be sown, would do the like.

Experiments in consort touching the seasons in which plants come forth.

577. There be some flowers, blossoms, grains, and fruits, which come more early, and others which come more late in the year. The flowers that come early with us are primroses, violets, anemonies, water-daffadillies, *crocus vernus*, and some early tulips. And they are all cold plants; which therefore, as it should seem, have a quicker perception of the heat of the sun increasing than the hot herbs have; as a cold hand will sooner find a little warmth than an hot. And those that come next after, are wall-flowers, cowslips, hyacinths, rosemary flowers, *etc.* and after them pinks, roses, flower-de-luces, *etc.* and the latest are gilly-flowers, holyoaks, larksfoot, *etc.* The earliest

blossoms are the blossoms of peaches, almonds, cornelians, mezerions, *etc.* and they are of such trees as have much moisture, either watery or oily. And therefore *crocus vernus* also, being an herb that hath an oily juice, putteth forth early; for those also find the sun sooner than the drier trees. The grains are, first rye and wheat; then oats and barley; then peas and beans. For though green peas and beans be eaten sooner, yet the dry ones that are used for horse-meat, are ripe last; and it seemeth that the fatter grain cometh first. The earliest fruits are strawberries, cherries, gooseberries, currants; and after them early apples, early pears, apricots, rasps; and after them, damascenes, and most kind of plums, peaches, *etc.* and the latest are apples, wardens, grapes, nuts, quinces, almonds, sloes, brier berries, hips, medlars, services, cornelians, *etc.*

578. It is to be noted, that, commonly, trees that ripen latest, blossom soonest; as peaches, cornelians, sloes, almonds, *etc.* and it seemeth to be a work of providence that they blossom so soon; for otherwise they could not have the sun long enough to ripen.

579. There be fruits, but rarely, that come twice a year; as some pears, strawberries, *etc.* And it seemeth they are such as abound with nourishment; whereby after one period, before the sun waxeth too weak, they can endure another. The violet also, amongst flowers, cometh twice a year, especially the double white; and that also is a plant full of moisture. Roses come twice, but it is not without cutting, as hath been formerly said.

580. In Muscovy, though the corn come not up till late spring, yet their harvest is as early as ours. The cause is, for that the strength of the ground is kept in with the snow; and we see with us, that if it be a long winter, it is commonly a more plentiful year: and after those kind of winters likewise, the flowers and corn, which are earlier and later, do come commonly at once, and at the same time; which troubleth the husbandman many times; for you shall have red roses and damask roses come together; and

likewise the harvest of wheat and barley. But this happeneth ever, for that the earlier stayeth for the later; and not that the later cometh sooner.

581. There be divers fruit trees in the hot countries, which have blossoms, and young fruit, and ripe fruit, almost all the year, succeeding one another. And it is said the orange hath the like with us, for a great part of summer; and so also hath the fig. And no doubt the natural motion of plants is to have so; but that either they want juice to spend; or they meet with the cold of the winter: and therefore this circle of ripening cannot be but in succulent plants and hot countries.

582. Some herbs are but annual, and die, root and all, once a year; as borage, lettuce, cucumbers, musk-melons, basil, tobacco, mustard-seed, and all kinds of corn: some continue many years; as hyssop, germander, lavender, fennel, *etc.* The cause of the dying is double; the first is the tenderness and weakness of the seed, which maketh the period in a small time; as it is in borage, lettuce, cucumbers, corn, *etc.* and therefore none of these are hot. The other cause is, for that some herbs can worse endure cold; as basil, tobacco, mustard-seed. And these have all much heat.

Experiments in consort touching the lasting of herbs and trees.

583. The lasting of plants is most in those that are largest of body; as oaks, elm, chestnut, the loat-tree, *etc.* and this holdeth in trees; but in herbs it is often contrary: for borage, colewort, pompions, which are herbs of the largest size, are of small durance; whereas hyssop, winter savoury, germander, thyme, sage, will last long. The cause is, for that trees last according to the strength and quantity of their sap and juice; being well munited by their bark against the injuries of the air: but herbs draw a weak juice, and have a soft stalk; and therefore those amongst them which last longest, are herbs of strong smell, and with a sticky stalk.

584. Trees that bear mast, and nuts, are commonly more lasting than those that bear fruits; especially the moister fruits: as oaks, beeches, chestnuts, walnuts, almonds, pine trees, *etc.* last longer than apples, pears, plums, *etc.* The cause is the fatness and oiliness of the sap; which ever wasteth less than the more watery.

585. Trees that bring forth their leaves late in the year, and cast them likewise late, are more lasting than those that sprout their leaves early, or shed them betimes. The cause is, for that the late coming forth sheweth a moisture more fixed; and the other more loose, and more easily resolved. And the same cause is, that wild trees last longer than garden trees; and in the same kind, those whose fruit is acid, more than those whose fruit is sweet.

586. Nothing procureth the lasting of trees, bushes and herbs so much as often cutting: for every cutting causeth a renovation of the juice of the plant; that it neither goeth so far, nor riseth so faintly, as when the plant is not cut; insomuch as annual plants, if you cut them seasonably, and will spare the use of them, and suffer them to come up still young, will last more years than one, as hath been partly touched; such as is lettuce, purslane, cucumber, and the like. And for great trees, we see almost all overgrown trees in church-yards, or near ancient buildings, and the like, are pollards, or dottards, and not trees at their full height.

587. Some experiment should be made, how by art to make plants more lasting than their ordinary period; as to make a stalk of wheat, *etc.* last a whole year. You must ever presuppose, that you handle it so as the winter killeth it not; for we speak only of prolonging the natural period. I conceive that the rule will hold, that whatsoever maketh the herb come later than its time, will make it last longer time: it were good to try it in a stalk of wheat, *etc.* set in the shade, and encompassed with a case of wood, not touching the straw, to keep out open air.

As for the preservation of fruits and plants, as well

upon the tree or stalk, as gathered, we shall handle it under the title of conservation of bodies.

Experiments in consort touching the several figures of plants.

588. The particular figures of plants we leave to their descriptions; but some few things in general we will observe. Trees and herbs, in the growing forth of their boughs and branches, are not figured, and keep no order. The cause is, for that the sap being restrained in the rind and bark, breaketh not forth at all, as in the bodies of trees, and stalks of herbs, till they begin to branch; and then when they make an eruption, they break forth casually, where they find best way in the bark or rind. It is true, that some trees are more scattered in their boughs; as sallow-trees, warden-trees, quince-trees, medlar-trees, lemon-trees, *etc.* some are more in the form of a pyramis, and come almost to todd; as the pear-tree, which the critics will have to borrow his name of πῦρ, fire, orange-trees, fir-trees, service-trees, lime-trees, *etc.* and some are more spread and broad; as beeches, hornbeam, *etc.* the rest are more indifferent. The cause of scattering the boughs, is the hasty breaking forth of the sap; and therefore those trees rise not in a body of any height, but branch near the ground. The cause of the pyramis is the keeping in of the sap long before it branch; and the spending of it, when it beginneth to branch, by equal degrees. The spreading is caused by the carrying up of the sap plentifully, without expence; and then putting it forth speedily and at once.

589. There be divers herbs, but no trees, that may be said to have some kind of order in the putting forth of their leaves: for they have joints or knuckles, as it were stops in their germination; as have gilly-flowers, pinks, fennel, corn, reeds, and canes. The cause whereof is, for that the sap ascendeth unequally, and doth, as it were, tire and stop by the way. And it seemeth they have some closeness and hardness in their stalk, which hindereth the sap from going up,

until it hath gathered into a knot, and so is more urged to put forth. And therefore they are most of them hollow when the stalk is dry, as fennel-stalk, stubble, and canes.

590. Flowers all have exquisite figures; and the flower numbers are chiefly five, and four; as in primroses, brier roses, single musk roses, single pinks, and gilly-flowers, *etc.* which have five leaves: lilies, flower-de-luces, borage, bugloss, *etc.* which have four leaves. But some put forth leaves not numbered; but they are ever small ones; as marygold, trefoil, *etc.* We see also, that the sockets and supporters of flowers are figured; as in the five brethren of the rose, sockets of gilly-flowers, *etc.* Leaves also are all figured; some round; some long; none square; and many jagged on the sides; which leaves of flowers seldom are. For I account the jagging of pinks and gilly-flowers, to be like the inequality of oak leaves, or vine leaves, or the like: but they seldom or never have any small purls.

Experiments in consort touching some principal differences in plants.

591. Of plants, some few put forth their blossoms before their leaves; as almonds, peaches, cornelians, black thorn, *etc.* but most put forth some leaves before their blossoms; as apples, pears, plums, cherries, white thorn, *etc.* The cause is, for that those that put forth their blossoms first, have either an acute and sharp spirit, and therefore commonly they all put forth early in the spring, and ripen very late; as most of the particulars before mentioned, or else an oily juice, which is apter to put out flowers than leaves.

592. Of plants, some are green all winter; others cast their leaves. There are green all winter, holly, ivy, box, fir, yew, cypress, juniper, bays, rosemary, *etc.* The cause of the holding green, is the close and compact substance of their leaves, and the pedicles of them. And the cause of that again is either the tough and viscous juice of the plant, or the strength and heat thereof. Of the first sort is holly;

which is of so viscous a juice, as they make birdlime of the bark of it. The stalk of ivy is tough, and not fragile, as we see in other small twigs dry. Fir yieldeth pitch. Box is a fast and heavy wood, as we see it in bowls. Yew is a strong and tough wood, as we see it in bows. Of the second sort is juniper, which is a wood odorate; and maketh a hot fire. Bays is likewise a hot and aromatical wood; and so is rosemany for a shrub. As for the leaves, their density appeareth, in that either they are smooth and shining, as in bays, holly, ivy, box, *etc.* or in that they are hard and spiry, as in the rest. And trial should be made of grafting of rosemary, and bays, and box, upon a holly-stock; because they are plants that come all winter. It were good to try it also with grafts of other trees, either fruit trees, or wild trees; to see whether they will not yield their fruit, or bear their leaves later and longer in the winter; because the sap of the holly putteth forth most in the winter. It may be also a mezerion-tree, grafted upon a holly, will prove both an earlier and a greater tree.

593. THERE be some plants that bear no flower, and yet bear fruit: there be some that bear flowers and no fruit: there be some that bear neither flowers nor fruit. Most of the great timber trees, as oaks, beeches, *etc.* bear no apparent flowers; some few likewise of the fruit trees; as mulberry, walnut, *etc.* and some shrubs, as juniper, holly, *etc.* bear no flowers. Divers herbs also bear seeds, which is as the fruit, and yet bear no flowers; as purslane, *etc.* Those that bear flowers and no fruit are few; as the double cherry, the sallow, *etc.* But for the cherry, it is doubtful whether it be not by art or culture; for if it be by art, then trial should be made, whether apple, and other fruits blossoms, may not be doubled. There are some few that bear neither fruit nor flower; as the elm, the poplars, box, brakes, *etc.*

594. THERE be some plants that shoot still upwards, and can support themselves; as the greatest part of trees and plants: there be some other that creep along the ground; or wind about other trees or props,

and cannot support themselves; as vines, ivy, brier, briony, woodbines, hops, climatis, camomile, *etc.* The cause is, as hath been partly touched, for that all plants naturally move upwards; but if the sap put up too fast, it maketh a slender stalk, which will not support the weight: and therefore these latter sort are all swift and hasty comers.

Experiments in consort touching all manner of composts, and helps of ground.

595. The first and most ordinary help is stercoration. The sheeps dung is one of the best; and next the dung of kine: and thirdly, that of horses, which is held to be somewhat too hot unless it be mingled. That of pigeons for a garden, or a small quantity of ground, excelleth. The ordering of dung is, if the ground be arable, to spread it immediately before the ploughing and sowing; and so to plough it in: for if you spread it long before, the sun will draw out much of the fatness of the dung: if the ground be grazing ground, to spread it somewhat late towards winter; that the sun may have the less power to dry it up. As for special composts for gardens, as a hot bed, *etc.* we have handled them before.

596. The second kind of compost is, the spreading of divers kinds of earths; as marle, chalk, sea sand, earth upon earth, pond earth; and the mixtures of them. Marle is thought to be the best, as having most fatness; and not heating the ground too much. The next is sea sand, which no doubt obtaineth a special virtue by the salt: for salt is the first rudiment of life. Chalk over-heateth the ground a little; and therefore is best upon cold clay grounds, or moist grounds: but I heard a great husband say that it was a common error, to think that chalk helpeth arable grounds, but helpeth not grazing grounds; whereas indeed it helpeth grass as well as corn: but that which breedeth the error is, because after the chalking of the ground they wear it out with many crops without rest; and then indeed afterwards it will bear little grass, because the ground is tired out.

It were good to try the laying of chalk upon arable grounds a little while before ploughing; and to plough it in as they do the dung; but then it must be friable first by rain or lying. As for earth, it composteth itself; for I knew a great garden that had a field, in a manner, poured upon it; and it did bear fruit excellently the first year of the planting: for the surface of the earth is ever the fruitfullest. And earth so prepared hath a double surface. But it is true, as I conceive, that such earth as hath salt-petre bred in it, if you can procure it without too much charge, doth excel. The way to hasten the breeding of salt-petre, is to forbid the sun, and the growth of vegetables. And therefore if you make a large hovel, thatched, over some quantity of ground; nay, if you do but plank the ground over, it will breed salt-petre. As for pond earth or river earth, it is a very good compost; especially if the pond have been long uncleansed, and so the water be not too hungry: and I judge it will be yet better if there be some mixture of chalk.

597. The third help of ground is, by some other substances that have a virtue to make ground fertile, though they be not merely earth; wherein ashes excel; insomuch as the countries about Ætna and Vesuvius have a kind of amends made them, for the mischief the eruptions many times do, by the exceeding fruitfulness of the soil, caused by the ashes scattered about. Soot also, though thin spread in a field or garden, is tried to be a very good compost. For salt is too costly; but it is tried, that mingled with seed-corn, and sown together, it doth good: and I am of opinion, that chalk in powder, mingled with seed-corn, would do good; perhaps as much as chalking the ground all over. As for the steeping of the seeds in several mixtures with water to give them vigour, or watering grounds with compost-water, we have spoken of them before.

598. The fourth help of ground is, the suffering of vegetables to die into the ground, and so to fatten it; as the stubble of corn, especially peas. Brakes cast upon the ground in the beginning of winter, will make

it very fruitful. It were good also to try whether leaves of trees swept together, with some chalk and dung mixed, to give them more heart, would not make a good compost; for there is nothing lost so much as leaves of trees; and as they lie scattered, and without mixture, they rather make the ground sour than otherwise.

599. The fifth help of ground is, heat and warmth. It hath been anciently practised to burn heath, and ling, and sedge, with the vantage of the wind, upon the ground. We see that warmth of walls and inclosures mendeth ground: we see also, that lying open to the south mendeth ground: we see again, that the foldings of sheep help ground, as well by their warmth as by their compost: and it may be doubted, whether the covering of the ground with brakes in the beginning of the winter, whereof we spake in the last experiment, helpeth it not, by reason of the warmth. Nay, some very good husbands do suspect, that the gathering up of flints in flinty ground, and laying them on heaps, which is much used, is no good husbandry, for that they would keep the ground warm.

600. The sixth help of ground is by watering and irrigation; which is in two manners; the one by letting in and shutting out waters at seasonable times: for water at some seasons, and with reasonable stay, doth good; but at some other seasons, and with too long stay, doth hurt: and this serveth only for meadows which are along some river. The other way is, to bring water from some hanging grounds, where there are springs, into the lower grounds, carrying it in some long furrows; and from those furrows, drawing it traverse to spread the water. And this maketh an excellent improvement, both for corn and grass. It is the richer, if those hanging grounds be fruitful, because it washeth off some of the fatness of the earth; but howsoever it profiteth much. Generally where there are great overflows in fens, or the like, the drowning of them in the winter maketh the summer following more fruitful: the cause may be, for that it

keepeth the ground warm, and nourisheth it. But the fen-men hold that the sewers must be kept so as the water may not stay too long in the spring till the weeds and sedge be grown up; for then the ground will be like a wood, which keepeth out the sun, and so continueth the wet; whereby it will never graze to purpose that year. Thus much for irrigation. But for avoidances, and drainings of water, where there is too much, and the helps of ground in that kind, we shall speak of them in another place.

NATURAL HISTORY.

CENTURY VII.

Experiments in consort touching the affinities and differences between plants and inanimate bodies.

601. THE differences between animate and inanimate bodies, we shall handle fully under the title of life, and living spirits, and powers. We shall therefore make but a brief mention of them in this place. The main differences are two. All bodies have spirits, and pneumatical parts within them; but the main differences between animate and inanimate, are two: the first is, that the spirits of things animate are all continued with themselves, and are branched in veins, and secret canals, as blood is: and in living creatures, the spirits have not only branches, but certain cells or seats, where the principal spirits do reside, and whereunto the rest do resort: but the spirits in things inanimate are shut in, and cut off by the tangible parts, and are not pervious one to another, as air is in snow. The second main difference is, that the spirits of animate bodies are all in some degree, more or less, kindled and inflamed; and have a fine commixture of flame, and an aërial substance. But inanimate bodies have their spirits no whit inflamed or kindled. And this difference consisteth not in the heat or coolness of spirits; for cloves and other spices, *naptha* and *petroleum*, have exceeding hot spirits, hotter a great deal than oil, wax, or tallow, *etc.* but not inflamed. And when any of those weak and temperate bodies come to be inflamed, then they gather a much greater heat than others have uninflamed, besides their light and motion, *etc.*

602. THE differences, which are secondary, and proceed from these two radical differences, are, first,

plants are all figurate and determinate, which inanimate bodies are not; for look how far the spirit is able to spread and continue itself, so far goeth the shape or figure, and then is determined. Secondly, plants do nourish; inanimate bodies do not: they have an accretion, but no alimentation. Thirdly, plants have a period of life, which inanimate bodies have not. Fourthly, they have a succession and propagation of their kind, which is not in bodies inanimate.

603. The differences between plants and metals or fossils, besides those four before mentioned, for metals I hold inanimate, are these: first, metals are more durable than plants: secondly, they are more solid and hard: thirdly, they are wholly subterrany; whereas plants are part above earth, and part under earth.

604. There be very few creatures that participate of the nature of plants and metals both; coral is one of the nearest of both kinds: another is vitriol, for that is aptest to sprout with moisture.

605. Another special affinity is between plants and mold or putrefaction: for all putrefaction, if it dissolve not in arefaction, will in the end issue into plants, or living creatures bred of putrefaction. I account moss, and mushrooms, and agaric, and other of those kinds, to be but molds of the ground, walls, and trees, and the like. As for flesh, and fish, and plants themselves, and a number of other things, after a moldiness, or rottenness, or corrupting, they will fall to breed worms. These putrefactions, which have affinity with plants, have this difference from them; that they have no succession or propagation, though they nourish, and have a period of life, and have likewise some figure.

606. I left once by chance a citron cut, in a close room, for three summer months that I was absent; and at my return there were grown forth, out of the pith cut, tufts of hairs an inch long, with little black heads, as if they would have been some herb.

Experiments in consort touching the affinities and differences of plants and living creatures, and the confiners and participles of them.

607. The affinities and differences between plants and living creatures are these that follow. They have both of them spirits continued, and branched, and also inflamed. But first in living creatures, the spirits have a cell or seat, which plants have not, as was also formerly said. And secondly, the spirits of living creatures hold more of flame than the spirits of plants do. And these two are the radical differences. For the secondary differences, they are as follow:—First, plants are all fixed to the earth, whereas all living creatures are severed, and of themselves. Secondly, living creatures have local motion, plants have not. Thirdly, living creatures nourish from their upper parts, by the mouth chiefly; plants nourish from below, namely, from the roots. Fourthly, plants have their seed and seminal parts uppermost; living creatures have them lowermost: and therefore it was said, not elegantly alone, but philosophically; *Homo est planta inversa*; Man is like a plant turned upwards: for the root in plants is as the head in living creatures. Fifthly, living creatures have a more exact figure than plants. Sixthly, living creatures have more diversity of organs within their bodies, and, as it were, inward figures, than plants have. Seventhly, living creatures have sense, which plants have not. Eighthly, living creatures have voluntary motion, which plants have not.

608. For the difference of sexes in plants, they are oftentimes by name distinguished; as male-piony, female-piony; male rosemary, female rosemary; he-holly, she-holly, *etc.* but generation by copulation certainly extendeth not to plants. The nearest approach of it is between the he-palm and the she-palm, which, as they report, if they grow near, incline the one to the other; insomuch as, that which is more strange, they doubt not to report, that to keep the trees upright from bending, they tie ropes or lines from the one to the other, that the contact might be

enjoyed by the contact of a middle body. But this may be feigned, or at least amplified. Nevertheless I am apt enough to think, that this same *binarium* of a stronger and a weaker, like unto masculine and feminine, doth hold in all living bodies. It is confounded sometimes; as in some creatures of putrefaction, wherein no marks of distinction appear: and it is doubled sometimes, as in hermaphrodites: but generally there is a degree of strength in most species.

609. The participles or confiners between plants and living creatures, are such chiefly as are fixed, and have no local motion of remove, though they have a motion in their parts; such as are oisters, cockles, and such like. There is a fabulous narration, that in the northern countries there should be an herb that groweth in the likeness of a lamb, and feedeth upon the grass, in such sort as it will bare the grass round about. But I suppose that the figure maketh the fable; for so, we see, there be bee-flowers, *etc.* And as for the grass, it seemeth the plant having a great stalk and top doth prey upon the grass a good way about, by drawing the juice of the earth from it.

Experiments promiscuous touching plants.

610. The Indian fig boweth its roots down so low in one year, as of itself it taketh root again; and so multiplieth from root to root, making of one tree a a kind of wood. The cause is the plenty of the sap, and the softness of the stalk, which maketh the bough, being over-loaden, and not stiffly upheld, weigh down. It hath leaves as broad as a little target, but the fruit no bigger than beans. The cause is, for that the continual shade increaseth the leaves, and abateth the fruit, which nevertheless is of a pleasant taste. And that no doubt is caused by the suppleness and gentleness of the juice of that plant, being that which maketh the boughs also so flexible.

611. It is reported by one of the ancients, that there is a certain Indian tree, having few but very great leaves, three cubits long and two broad; and that the fruit, being of good taste, groweth out of the bark.

It may be, there be plants that pour out the sap so fast, as they have no leisure either to divide into many leaves, or to put forth stalks to the fruit. With us trees, generally, have small leaves in comparison. The fig hath the greatest; and next it the vine, mulberry, and sycamore; and the least are those of the willow, birch, and thorn. But there be found herbs with far greater leaves than any tree; as the bur, gourd, cucumber, and colewort. The cause is, like to that of the Indian fig, the hasty and plentiful putting forth of the sap.

612. There be three things in use for sweetness; sugar, honey, manna. For sugar, to the ancients it was scarce known, and little used. It is found in canes: *Query*, whether to the first knuckle, or farther up? And whether the very bark of the cane itself do yield sugar, or no? For honey, the bee maketh it, or gathereth it; but I have heard from one that was industrious in husbandry, that the labour of the bee is about the wax; and that he hath known in the beginning of May honeycombs empty of honey; and within a fortnight, when the sweet dews fall, filled like a cellar. It is reported also by some of the ancients, that there is a tree called Occhus, in the valley of Hyrcania, that distilleth honey in the mornings. It is not unlike that the sap and tears of some trees may be sweet. It may be also, that some sweet juices, fit for many uses, may be concocted out of fruits, to the thickness of honey, or perhaps of sugar; the likeliest are raisins of the sun, figs, and currants; the means may be inquired.

613. The ancients report of a tree by the Persian sea, upon the shore-sands, which is nourished with the salt water; and when the tide ebbeth, you shall see the roots as it were bare without bark, being as it seemeth corroded by the salt, and grasping the sands like a crab; which nevertheless beareth a fruit. It were good to try some hard trees, as a service-tree, or fir-tree, by setting them within the sands.

614. There be of plants which they use for garments, these that follow: hemp, flax, cotton, nettles,

whereof they make nettle-cloth, *sericum*, which is a growing silk; they make also cables of the bark of lime-trees. It is the stalk that maketh the filaceous matter commonly; and sometimes the down that groweth above.

615. They have in some countries a plant of a rosy colour, which shutteth in the night, openeth in the morning, and openeth wide at noon; which the inhabitants of those countries say is a plant that sleepeth. There be sleepers enough then; for almost all flowers do the like.

616. Some plants there are, but rare, that have a mossy or downy root; and likewise that have a number of threads, like beards; as mandrakes; whereof witches and impostures make an ugly image, giving it the form of a face at the top of the root, and leaving those strings to make a broad beard down to the foot. Also there is a kind of nard in Crete, being a kind of *phu*, that hath a root hairy, like a rough-footed dove's foot. So as you may see, there are of roots, bulbous roots, fibrous roots, and hirsute roots. And, I take it, in the bulbous, the sap hasteneth most to the air and sun: in the fibrous, the sap delighteth more in the earth, and therefore putteth downward; and the hirsute is a middle between both, that besides the putting forth upwards and downwards, putteth forth in round.

617. There are some tears of trees, which are combed from the beards of goats: for when the goats bite and crop them, especially in the mornings, the dew being on, the tear cometh forth, and hangeth upon their beards: of this sort is some kind of *laudanum*.

618. The irrigation of the plane-tree by wine, is reported by the ancients to make it fruitful. It should be tried likewise with roots; for upon seeds it worketh no great effects.

619. The way to carry foreign roots a long way, is to vessel them close in earthen vessels. But if the vessels be not very great, you must make some holes in the bottom, to give some refreshment to the roots;

which otherwise, as it seemeth, will decay and suffocate.

620. The ancient cinnamon was, of all other plants, while it grew, the driest; and those things which are known to comfort other plants, did make that more steril; for in showers it prospered worst: it grew also amongst bushes of other kinds, where commonly plants do not thrive; neither did it love the sun. There might be one cause of all those effects; namely, the sparing nourishment which that plant required. *Query*, how far *cassia*, which is now the substitute of cinnamon, doth participate of these things?

621. It is reported by one of the ancients, that *cassia*, when it is gathered, is put into the skins of beasts newly flayed; and that the skins corrupting and breeding worms, the worms do devour the pith and marrow of it, and so make it hollow; but meddle not with the bark, because to them it is bitter.

622. There were in ancient time vines of far greater bodies than we know any; for there have been cups made of them, and an image of Jupiter. But it is like they were wild vines; for the vines that they use for wine, are so often cut, and so much digged and dressed, that their sap spendeth into the grapes, and so the stalk cannot increase much in bulk. The wood of vines is very durable, without rotting. And that which is strange, though no tree hath the twigs, while they are green, so brittle, yet the wood dried is extreme tough; and was used by the captains of armies amongst the Romans for their cudgels.

623. It is reported, that in some places vines are suffered to grow like herbs, spreading upon the ground; and that the grapes of those vines are very great. It were good to make trial, whether plants that use to be borne up by props, will not put forth greater leaves and greater fruits if they be laid along the ground; as hops, ivy, woodbine, *etc.*

624. Quinces, or apples, *etc.* if you will keep them long, drown them in honey; but because honey, perhaps, will give them a taste over luscious, it were good to make trial in powder of sugar, or in syrup

of wine, only boiled to height. Both these should likewise be tried in oranges, lemons, and pomegranates; for the powder of sugar, and syrup of wine, will serve for more times than once.

625. The conservation of fruit should be also tried in vessels filled with fine sand, or with powder of chalk, or in meal and flour; or in dust of oak wood; or in mill.

626. Such fruits as you appoint for long keeping, you must gather before they be full ripe; and in a fair and dry day towards noon; and when the wind bloweth not south; and when the moon is under the earth, and in decrease.

627. Take grapes, and hang them in an empty vessel well stopped; and set the vessel not in a cellar, but in some dry place; and it is said they will last long. But it is reported by some, they will keep better in a vessel half full of wine, so that the grapes touch not the wine.

628. It is reported, that the preserving of the stalk helpeth to preserve the grape; especially if the stalk be put into the pith of alder, the alder not touching the fruit.

629. It is reported by some of the ancients, that fruit put in bottles, and the bottles let down into wells under water, will keep long.

630. Of herbs and plants, some are good to eat raw; as lettuce, endive, purslane, tarragon, cresses, cucumbers, musk-melons, radish, *etc.* others only after they are boiled, or have passed the fire; as parsley, clary, sage, parsnips, turnips, asparagus, artichokes, though they also being young, are eaten raw: but a number of herbs are not esculent at all; as wormwood, grass, green corn, centaury, hyssop, lavender, balm, *etc.* The causes are, for that the herbs that are not esculent, do want the two tastes in which nourishment resteth; which are fat and sweet; and have, contrariwise, bitter and over-strong tastes, or a juice so crude as cannot be ripened to the degree of nourishment. Herbs and plants that are esculent raw, have fatness or sweetness, as all esculent fruits; such

are onions, lettuce, *etc.* But then it must be such a fatness, for as for sweet things, they are in effect always esculent, as is not over-gross, and loading of the stomach: for parsnips and leeks have fatness; but it is too gross and heavy without boiling. It must be also in a substance somewhat tender; for we see wheat, barley, artichokes, are no good nourishment till they have passed the fire; but the fire doth ripen, and maketh them soft and tender, and so they become esculent. As for radish and tarragon, and the like, they are for condiments, and not for nourishment. And even some of those herbs which are not esculent, are notwithstanding poculent; as hops, broom, *etc.* *Query*, what herbs are good for drink besides the two aforenamed; for that it may, perhaps, ease the charge of brewing, if they make beer to require less malt, or make it last longer.

631. Parts fit for the nourishment of man in plants are, seeds, roots, and fruits; but chiefly seeds and roots. For leaves, they give no nourishment at all, or very little: no more do flowers, or blossoms, or stalks. The reason is, for that roots, and seeds, and fruits, inasmuch as all plants consist of an oily and watery substance commixed, have more of the oily substance; and leaves, flowers, *etc.* of the watery. And secondly, they are more concocted; for the root which continueth ever in the earth, is still concocted by the earth; and fruits and grains we see are half a year or more in concocting; whereas leaves are out and perfect in a month.

632. Plants, for the most part, are more strong both in taste and smell in the seed, than in the leaf and root. The cause is, for that in plants that are not of a fierce and eager spirit, the virtue is increased by concoction and maturation, which is ever most in the seed; but in plants that are of a fierce and eager spirit, they are stronger whilst the spirit is inclosed in the root; and the spirits do but weaken and dissipate when they come to the air and sun; as we see it in onions, garlick, dragon, *etc.* Nay, there be plants that have their roots very hot and aromatical, and

their seeds rather insipid; as ginger. The cause is, as was touched before, for that the heat of those plants is very dissipable; which under the earth is contained and held in; but when it cometh to the air it exhaleth.

633. The juices of fruits are either watery or oily. I reckon among the watery, all the fruits out of which drink is expressed; as the grape, the apple, the pear, the cherry, the pomegranate, *etc.* And there are some others which, though they be not in use for drink, yet they appear to be of the same nature; as plums, services, mulberries, rasps, oranges, lemons, *etc.* and for those juices that are so fleshy, as they cannot make drink by expression, yet, perhaps, they may make drink by mixture of water.

Poculaque admistis imitantur vitea sorbis.

And it may be hips and brier-berries would do the like. Those that have oily juices, are olives, almonds, nuts of all sorts, pine-apples, *etc.* and their juices are all inflammable. And you must observe also, that some of the watery juices, after they have gathered spirit, will burn and inflame; as wine. There is a third kind of fruit that is sweet, without either sharpness or oiliness: such as is the fig and the date.

634. It hath been noted, that most trees, and specially those that bear mast, are fruitful but once in two years. The cause, no doubt, is the expence of sap; for many orchard trees, well cultured, will bear divers years together.

635. There is no tree, which besides the natural fruit doth bear so many bastard fruits as the oak doth: for besides the acorn, it beareth galls, oak apples, and certain oak nuts, which are inflammable; and certain oak berries, sticking close to the body of the tree without stalk. It beareth also misseltoe, though rarely. The cause of all these may be, the closeness and solidness of the wood and pith of the oak, which maketh several juices find several eruptions. And therefore if you will devise to make any super-plants, you must ever give the sap plentiful rising and hard issue.

636. There are two excrescences which grow upon trees; both of them in the nature of mushrooms: the one the Romans call *boletus;* which groweth upon the roots of oaks; and was one of the dainties of their table; the other is medicinal, that is called agaric, whereof we have spoken before, which groweth upon the tops of oaks; though it be affirmed by some, that it groweth also at the roots. I do conceive, that many excrescences of trees grow chiefly where the tree is dead or faded; for that the natural sap of the tree corrupteth into some preternatural substance.

637. The greater part of trees bear most and best on the lower boughs; as oaks, figs, walnuts, pears, *etc.* but some bear best on the top boughs; as crabs, *etc.* Those that bear best below, are such as shade doth more good to than hurt. For generally all fruits bear best lowest; because the sap tireth not, having but a short way: and therefore in fruits spread upon walls, the lowest are the greatest, as was formerly said: so it is the shade that hindereth the lower boughs; except it be in such trees as delight in shade, or at least bear it well. And therefore they are either strong trees, as the oak; or else they have large leaves, as the walnut and fig; or else they grow in pyramids, as the pear. But if they require very much sun, they bear best on the top; as it is in crabs, apples, plums, *etc.*

638. There be trees that bear best when they begin to be old; as almonds, pears, vines, and all trees that give mast. The cause is, for that all trees that bear mast, have an oily fruit; and young trees have a more watery juice, and less concocted; and of the same kind also is the almond. The pear likewise, though it be not oily, yet it requireth much sap, and well concocted; for we see it is a heavy fruit and solid; much more than apples, plums, *etc.* As for the vine, it is noted, that it beareth more grapes when it is young; but grapes that make better wine when it is old; for that the juice is better concocted: and we see that wine is inflammable; so as it hath a kind of oiliness. But the most part of trees, amongst

which are apples, plums. *etc.* bear best when they are young.

639. There be plants that have a milk in them when they are cut; as figs, old lettuce, sow-thistles, spurge, *etc.* The cause may be an inception of putrefaction: for those milks have all an acrimony: though one would think they should be lenitive. For if you write upon paper with the milk of the fig, the letters will not be seen, until you hold the paper before the fire, and then they wax brown; which sheweth that it is sharp or fretting juice: lettuce is thought poisonous, when it is so old as to have milk; spurge is a kind of poison in itself; and as for sow-thistles, though coneys eat them, yet sheep and cattle will not touch them: and besides, the milk of them rubbed upon warts, in short time weareth them away; which sheweth the milk of them to be corrosive. We see also that wheat and other corn, sown, if you take them forth of the ground before they sprout, are full of milk; and the beginning of germination is ever a kind of putrefaction of the seed. Euphorbium also hath a milk, though not very white, which is of a great acrimony: and salladine hath a yellow milk, which hath likewise much acrimony; for it cleanseth the eyes. It is good also for cataracts.

640. Mushrooms are reported to grow, as well upon the bodies of trees, as upon their roots, or upon the earth; and especially upon the oak. The cause is, for that strong trees are towards such excrescences in the nature of earth; and therefore put forth moss, mushrooms, and the like.

641. There is hardly found a plant that yieldeth a red juice in the blade or ear; except it be the tree that beareth *sanguis draconis;* which groweth chiefly in the island Socotra: the herb amaranthus indeed is red all over; and brazil is red in the wood: and so is red sanders. The tree of the *sanguis draconis* groweth in the form of a sugar-loaf. It is like the sap of that plant concocteth in the body of the tree. For we see that grapes and pomegranates are red in the juice, but are green in the tear; and this maketh the tree of *sanguis*

draconis lesser towards the top; because the juice hasteneth not up; and besides, it is very astringent; and therefore of slow motion.

642. It is reported, that sweet moss, besides that upon the apple trees, groweth likewise sometimes upon poplars; and yet generally the poplar is a smooth tree of bark, and hath little moss. The moss of the larix-tree burneth also sweet, and sparkleth in the burning. *Query* of the mosses of odorate trees; as cedar, cyprus, *lignum aloës, etc.*

643. The death that is most without pain, hath been noted to be upon the taking of the potion of hemlock; which in humanity was the form of execution of capital offenders in Athens. The poison of the asp, that Cleopatra used, hath some affinity with it. The cause is, for that the torments of death are chiefly raised by the strife of the spirits; and these vapours quench the spirits by degrees; like to the death of an extreme old man. I conceive it is less painful than *opium*, because *opium* hath parts of heat mixed.

644. There be fruits that are sweet before they be ripe, as mirobalanes; so fennel seeds are sweet before they ripen, and after grow spicy. And some never ripen to be sweet; as tamarinds, berberries, crabs, sloes, *etc.* The cause is, for that the former kind have much and subtle heat, which causeth early sweetness; the latter have a cold and acid juice, which no heat of the sun can sweeten. But as for the myrobalane, it hath parts of contrary natures; for it is sweet and yet astringent.

645. There be few herbs that have a salt taste; and contrariwise all blood of living creatures hath a saltness. The cause may be, for that salt, though it be the rudiment of life, yet in plants the original taste remaineth not; for you shall have them bitter, sour, sweet, biting, but seldom salt; but in living creatures, all those high tastes may happen to be sometimes in the humours, but are seldom in the flesh or substance, because it is of a more oily nature; which is not very susceptible of those tastes; and the saltness itself of

blood is but a light and secret saltness; and even among plants, some do participate of saltness, as *alga marina*, samphire, scurvy-grass, *etc.* And they report, there is in some of the Indian seas a swimming plant, which they call *salgazus*, spreading over the sea in such sort, as one would think it were a meadow. It is certain, that out of the ashes of all plants they extract a salt which they use in medicines.

646. It is reported by one of the ancients, that there is an herb growing in the water, called *lincostis*, which is full of prickles: this herb putteth forth another small herb out of the leaf; which is imputed to some moisture that is gathered between the prickles, which putrified by the sun germinateth. But I remember also I have seen, for a great rarity, one rose grow out of another like honeysuckles, that they call top and top-gallants.

647. Barley, as appeareth in the malting, being steeped in water three days, and afterwards the water drained from it, and the barley turned upon a dry floor, will sprout half an inch long at least: and if it be let alone, and not turned, much more; until the heart be out. Wheat will do the same. Try it also with pease and beans. This experiment is not like that of the orpine and semper-vive; for there it is of the old store, for no water is added; but here it is nourished from the water. The experiment should be farther driven: for it appeareth already, by that which hath been said, that earth is not necessary to the first sprouting of plants; and we see that rose-buds set in water will blow: therefore try whether the sprouts of such grains may not be raised to a farther degree, as to an herb or flower, with water only, or some small commixture of earth: for if they will, it should seem by the experiments before, both of the malt and of the roses, that they will come far faster on in water than in earth; for the nourishment is easilier drawn out of water than out of earth. It may give some light also, that drink infused with flesh, as that with the capon, *etc.* will nourish faster and easilier than meat and drink together. Try the

same experiment with roots as well as with grains: as for example, take a turnip, and steep it a while, and then dry it, and see whether it will sprout.

648. Malt in the drenching will swell; and that in such a manner, as after the putting forth in sprouts, and the drying upon the kiln, there will be gained at least a bushel in eight, and yet the sprouts are rubbed off; and there will be a bushel of dust besides the malt: which I suppose to be, not only by the loose and open lying of the parts, but by some addition of substance drawn from the water in which it was steeped.

649. Malt gathereth a sweetness to the taste, which appeareth yet more in the wort. The dulceration of things is worthy to be tried to the full: for that dulceration importeth a degree to nourishment: and the making of things inalimental to become alimental, may be an experiment of great profit for making new victual.

650. Most seeds in the growing, leave their husk or rind about the root; but the onion will carry it up, that it will be like a cap upon the top of the young onion. The cause may be, for that the skin or husk is not easy to break; as we see by the pilling of onions, what a holding substance the skin is.

651. Plants, that have curled leaves, do all abound with moisture; which cometh so fast on, as they cannot spread themselves plain, but must needs gather together. The weakest kind of curling is roughness; as in clary and burr. The second is curling on the sides; as in lettuce, and young cabbage: and the third is folding into an head; as in cabbage full grown, and cabbage-lettuce.

652. It is reported, that fir and pine, especially if they be old and putrified, though they shine not as some rotten woods do, yet in the sudden breaking they will sparkle like hard sugar.

653. The roots of trees do some of them put downwards deep into the ground; as the oak, pine, fir, *etc.* Some spread more towards the surface of the earth; as the ash, cypress-tree, olive, *etc.* The cause of this

latter may be, for that such trees as love the sun, do not willingly descend far into the earth; and therefore they are, commonly, trees that shoot up much; for in their body their desire of approach to the sun maketh them spread the less. And the same reason under ground, to avoid recess from the sun, maketh them spread the more. And we see it cometh to pass in some trees which have been planted too deep in the ground, that for love of approach to the sun, they forsake their first root, and put out another more towards the top of the earth. And we see also, that the olive is full of oily juice; and ash maketh the best fire; and cypress is an hot tree. As for the oak, which is of the former sort, it loveth the earth; and therefore groweth slowly. And for the pine and fir likewise, they have so much heat in themselves, as they need less the heat of the sun. There be herbs also that have the same difference; as the herb they call *morsus diaboli;* which putteth the root down so low, as you cannot pull it up without breaking; which gave occasion to the name and fable; for that it was said, it was so wholesome a root, that the devil, when it was gathered, bit it for envy: and some of the ancients do report, that there was a goodly fir, which they desired to remove whole, that had a root under ground eight cubits deep; and so the root came up broken.

654. It hath been observed, that a branch of a tree, being unbarked some space at the bottom, and so set into the ground, hath grown; even of such trees, as if the branch were set with the bark on, they would not grow; yet contrariwise we see, that a tree pared round in the body above ground, will die. The cause may be, for that the unbarked part draweth the nourishment best, but the bark continueth it only.

655. Grapes will continue fresh and moist all winter long, if you hang them cluster by cluster in the roof of a warm room; especially if when you gather the cluster, you take off with the cluster some of the stock.

656. The reed or cane is a watery plant, and

groweth not but in the water; it hath these properties; that it is hollow; that it is knuckled both stalk and root; that being dry, it is more hard and fragile than other wood; that it putteth forth no boughs, though many stalks come out of one root. It differeth much in greatness; the smallest being fit for thatching of houses, and stopping the chinks of ships, better than glue or pitch. The second bigness is used for angle rods and staves; and in China for beating of offenders upon the thighs. The differing kinds of them are, the common reed, the *cassia fistula*, and the sugar-reed. Of all plants it boweth the easiest, and riseth again. It seemeth, that amongst plants which are nourished with mixture of earth and water, it draweth most nourishment from water; which maketh it the smoothest of all others in bark, and the hollowest in body.

657. The sap of trees when they are let blood, is of differing natures. Some more watery and clear; as that of vines, of beeches, of pears: some thick, as apples: some gummy, as cherries: some frothy, as elms: some milky, as figs. In mulberries the sap seemeth to be almost towards the bark only; for if you cut the tree a little into the bark with a stone, it will come forth; if you pierce it deeper with a tool, it will be dry. The trees which have the moistest juices in their fruit, have commonly the moistest sap in their body; for the vines and pears are very moist; apples somewhat more spungy: the milk of the fig hath the quality of the rennet, to gather cheese; and so have certain sour herbs wherewith they make cheese in Lent.

658. The timber and wood are in some trees more clean, in some more knotty; and it is a good trial to try it by speaking at one end, and laying the ear at the other: for if it be knotty, the voice will not pass well. Some have the veins more varied and chambletted; as oak, whereof wainscot is made; maple, whereof trenchers are made: some more smooth, as fir and walnut: some do more easily breed worms and spiders; some more hardly, as it is said of Irish trees:

besides there be a number of differences that concern their use; as oak, cedar, and chestnut, are the best builders; some are best for plough-timber, as ash; some for piers, that are sometimes wet and sometimes dry, as elm; some for planchers, as deal; some for tables, cupboards, and desks, as walnuts; some for ship-timber, as oaks that grow in moist grounds; for that maketh the timber tough, and not apt to rift with ordnance; wherein English and Irish timber are thought to excel: some for masts of ships, as fir and pine, because of their length, straightness, and lightness: some for pale, as oak; some for fuel, as ash; and so of the rest.

659. The coming of trees and plants in certain regions, and not in others, is sometimes casual: for many have been translated, and have prospered well; as damask-roses, that have not been known in England above an hundred years, and now are so common. But the liking of plants in certain soils more than in others, is merely natural; as the fir and pine love the mountains; the poplar, willow, sallow, and alder, love rivers and moist places; the ash loveth coppices, but is best in standards alone; juniper loveth chalk; and so do most fruit-trees; samphire groweth but upon rocks; reeds and osiers grow where they are washed with water; the vine loveth sides of hills, turning upon the south-east sun, *etc.*

660. The putting forth of certain herbs discovereth of what nature the ground where they put forth is; as wild thyme sheweth good feeding-ground for cattle; betony and strawberries shew ground fit for wood; camomile sheweth mellow grounds fit for wheat. Mustard-seed, growing after the plough, sheweth a good strong ground also for wheat: burnet sheweth good meadow, and the like.

661. There are found in divers countries, some other plants that grow out of trees and plants, besides misseltoe: as in Syria there is an herb called *cassytas*, that groweth out of tall trees, and windeth itself about the same tree where it groweth, and sometimes about thorns. There is a kind of polypode that grow-

eth out of trees, though it windeth not. So likewise an herb called *faunos*, upon the wild olive. And an herb called *hyppophæston* upon the fullers thorn: which, they say, is good for the falling sickness.

662. It hath been observed by some of the ancients, that howsoever cold and easterly winds are thought to be great enemies to fruit, yet nevertheless south winds are also found to do hurt, especially in the blossoming time; and the more if showers follow. It seemeth they call forth the moisture too fast. The west winds are the best. It hath been observed also, that green and open winters do hurt trees; insomuch as if two or three such winters come together, almond-trees, and some other trees, will die. The cause is the same with the former, because the lust of the earth over-spendeth itself: howsoever some other of the ancients have commended warm winters.

663. Snows lying long cause a fruitful year; for first, they keep in the strength of the earth; secondly, they water the earth better than rain: for in snow, the earth doth, as it were, suck the water as out of the teat: thirdly, the moisture of snow is the finest moisture, for it is the froth of the cloudy waters.

664. Showers, if they come a little before the ripening of fruits, do good to all succulent and moist fruits; as vines, olives, pomegranates; yet it is rather for plenty than for goodness; for the best vines are in the driest vintages: small showers are likewise good for corn, so as parching heats come not upon them. Generally night showers are better than day showers, for that the sun followeth not so fast upon them; and we see even in watering by the hand, it is best in summer time to water in the evening.

665. The differences of earths, and the trial of them, are worthy to be diligently inquired. The earth that with showers doth easiliest soften, is commended; and yet some earth of that kind will be very dry and hard before the showers. The earth that casteth up from the plough a great clod, is not so good as that which casteth up a smaller clod. The earth that putteth forth moss easily, and may be called

mouldy, is not good. The earth that smelleth well upon the digging, or ploughing, is commended; as containing the juice of vegetables almost already prepared. It is thought by some, that the ends of low rainbows fall more upon one kind of earth than upon another; as it may well be; for that that earth is most roscid: and therefore it is commended for a sign of good earth. The poorness of the herbs, it is plain, shew the poorness of the earth; and especially if they be in colour more dark: but if the herbs shew withered, or blasted at the top, it sheweth the earth to be very cold; and so doth the mossiness of trees. The earth whereof the grass is soon parched with the sun, and toasted, is commonly forced earth, and barren in its own nature. The tender, chessome, and mellow earth, is the best, being mere mold, between the two extremes of clay and sand, especially if it be not loamy and binding. The earth, that after rain will scarce be ploughed, is commonly fruitful: for it is cleaving, and full of juice.

666. It is strange, which is observed by some of the ancients, that dust helpeth the fruitfulness of trees, and of vines by name; insomuch as they cast dust upon them of purpose. It should seem, that that powdering, when a shower cometh, maketh a kind of soiling to the tree, being earth and water finely laid on. And they note, that countries where the fields and ways are dusty bear the best vines.

667. It is commended by the ancients for an excellent help to trees, to lay the stalks and leaves of lupins about the roots, or to plough them into the ground where you will sow corn. The burning also of the cuttings of vines, and casting them upon land, doth much good. And it was generally received of old, that dunging of grounds when the west wind bloweth, and in the decrease of the moon, doth greatly help; the earth, as it seemeth, being then more thirsty and open to receive the dung.

668. The grafting of vines upon vines, as I take it, is not now in use: the ancients had it, and that three ways: the first was incision, which is the ordinary

manner of grafting: the second was terebration through the middle of the stock, and putting in the cions there: and the third was paring of two vines that grow together to the marrow, and binding them close.

669. The diseases and ill accidents of corn are worthy to be inquired; and would be more worthy to be inquired, if it were in mens power to help them; whereas many of them are not to be remedied. The mildew is one of the greatest, which, out of question, cometh by closeness of air; and therefore in hills, or large champain grounds, it seldom cometh; such as is with us York's woald. This cannot be remedied, otherwise than that in countries of small inclosure the grounds be turned into larger fields: which I have known to do good in some farms. Another disease is the putting forth of wild oats, whereinto corn oftentimes, especially barley, doth degenerate. It happeneth chiefly from the weakness of the grain that is sown; for if it be either too old or mouldy, it will bring forth wild oats. Another disease is the satiety of the ground; for if you sow one ground still with the same corn, I mean not the same corn that grew upon the same ground, but the same kind of grain, as wheat, barley, *etc.* it will prosper but poorly: therefore, besides the resting of the ground, you must vary the seed. Another ill accident is from the winds, which hurt at two times; at the flowering, by shaking of the flowers; and at the full ripening, by shaking out the corn. Another ill accident is drought, at the spindling of the corn, which with us is rare, but in hotter countries common: insomuch as the word *calamitas* was first derived from *calamus*, when the corn could not get out of the stalk. Another ill accident is over-wet at sowing time, which with us breedeth much dearth, insomuch as the corn never cometh up; and many times they are forced to resow summer corn where they sowed winter corn. Another ill accident is bitter frosts continued without snow, especially in the beginning of the winter, after the seed is new sown. Another disease is worms, which some-

times breed in the root, and happen upon hot suns and showers immediately after the sowing; and another worm breedeth in the ear itself, especially when hot suns break often out of clouds. Another disease is weeds; and they are such as either choke and overshadow the corn, and bear it down; or starve the corn, and deceive it of nourishment. Another disease is over-rankness of the corn; which they used to remedy by mowing it after it is come up; or putting sheep into it. Another ill accident is laying of corn with great rains, near or in harvest. Another ill accident is, if the seed happen to have touched oil, or any thing that is fat; for those substances have an antipathy with nourishment of water.

670. The remedies of the diseases of corn have been observed as followeth. The steeping of the grain, before sowing, a little time in wine, is thought a preservative: the mingling of seed-corn with ashes is thought to be good: the sowing at the wane of the moon, is thought to make the corn sound; it hath not been practised, but it is thought to be of use to make some mixture in corn; as if you sow a few beans with wheat, your wheat will be the better. It hath been observed, that the sowing of corn with housleek doth good. Though grain that toucheth oil or fat, receiveth hurt, yet the steeping of it in the dregs of oil, when it beginneth to putrify, which they call *amurca*, is thought to assure it against worms. It is reported also, that if corn be mowed, it will make the grain longer, but emptier, and having more of the husk.

671. It hath been noted, that seed of a year old is the best; and of two or three years is worse; and that which is more old is quite barren; though, no doubt, some seed and grains last better than others. The corn which in the fanning lieth lowest is the best: and the corn which broken or bitten retaineth a little yellowness, is better than that which is very white.

672. It hath been observed, that of all roots of herbs, the root of sorrel goeth the farthest into the earth; insomuch that it hath been known to go three cubits deep: and that it is the root that continueth fit

longest to be set again, of any root that groweth. It is a cold and acid herb, that, as it seemeth, loveth the earth, and is not much drawn by the sun.

673. It hath been observed, that some herbs like best being watered with salt water; as radish, beet, rue, pennyroyal; this trial should be extended to some other herbs; especially such as are strong, as tarragon, mustard-seed, rocket, and the like.

674. It is strange that is generally received, how some poisonous beasts affect odorate and wholesome herbs; as that the snake loveth fennel; that the toad will be much under sage; that frogs will be in cinquefoil. It may be it is rather the shade, or other coverture, that they take liking in, than the virtue of the herb.

675. It were a matter of great profit, save that I doubt it is too conjectural to venture upon, if one could discern what corn, herbs, or fruits, are like to be in plenty or scarcity, by some signs and prognostics in the beginning of the year: for as for those that are like to be in plenty, they may be bargained for upon the ground; as the old relation was of Thales; who, to shew how easy it was for a philosopher to be rich, when he foresaw a great plenty of olives, made a monopoly of them. And for scarcity, men may make profit in keeping better the old store. Long continuance of snow is believed to make a fruitful year of corn: an early winter, or a very late winter, a barren year of corn: an open and serene winter, an ill year of fruit: these we have partly touched before: but other prognostics of like nature are diligently to be inquired.

676. There seem to be in some plants singularities, wherein they differ from all other; the olive hath the oily part only on the outside; whereas all other fruits have it in the nut or kernel. The fir hath, in effect, no stone, nut, nor kernel; except you will count the little grains kernels. The pomegranate and pine-apple have only amongst fruits grains distinct in several cells. No herbs have curled leaves but cabbage and cabbage-lettuce. None have doubled leaves,

one belonging to the stalk, another to the fruit or seed, but the artichoke. No flower hath that kind of spread that the woodbine hath. This may be a large field of contemplation; for it sheweth that in the frame of nature, there is, in the producing of some species, a composition of matter, which happeneth oft, and may be much diversified: in others, such as happeneth rarely, and admitteth little variety: for so it is likewise in beasts: dogs have a resemblance with wolves and foxes; horses with asses; kine with buffles; hares with coneys, *etc.* And so in birds: kites and kestrels have a resemblance with hawks; common doves with ring-doves and turtles; blackbirds with thrushes and mavises; crows with ravens, daws, and choughs, *etc.* But elephants and swine amongst beasts; and the bird of paradise and the peacock amongst birds; and some few others have scarce any other species that have affinity with them.

We leave the description of plants, and their virtues, to herbalists, and other like books of natural history; wherein mens diligence hath been great, even to curiosity: for our experiments are only such as do ever ascend a degree to the deriving of causes, and extracting of axioms, which we are not ignorant but that some both of the ancient and modern writers have also laboured; but their causes and axioms are so full of imagination, and so infected with the old received theories, as they are mere inquinations of experience, and concoct it not.

Experiment solitary touching healing of wounds.

677. It hath been observed by some of the ancients, that skins, especially of rams, newly pulled off, and applied to the wounds of stripes, do keep them from swelling and exulcerating; and likewise heal them and close them up; and that the whites of eggs do the same. The cause is a temperate conglutination; for both bodies are clammy and viscous, and do bridle the deflux of humours to the hurts, without penning them in too much.

Experiment solitary touching fat diffused in flesh.

678. You may turn almost all flesh into a fatty substance, if you take flesh and cut it into pieces, and put the pieces into a glass covered with parchment; and so let the glass stand six or seven hours in boiling water. It may be an experiment of profit for making of fat or grease for many uses; but then it must be of such flesh as is not edible; as horses, dogs, bears, foxes, badgers, *etc.*

Experiment solitary touching ripening of drink before the time.

679. It is reported by one of the ancients, that new wine put into vessels well stopped, and the vessels let down into the sea, will accelerate very much the making of them ripe and potable. The same should be tried in wort.

Experiment solitary touching pilosity and plumage.

680. Beasts are more hairy than men, and savage men more than civil; and the plumage of birds exceedeth the pilosity of beasts. The cause of the smoothness in men is not any abundance of heat and moisture, though that indeed causeth pilosity; but there is requisite to pilosity, not so much heat and moisture, as excrementitious heat and moisture, for whatsoever assimilateth, goeth not into the hair, and excrementitious moisture aboundeth most in beasts, and men that are more savage. Much the same reason is there of the plumage of birds; for birds assimilate less, and excern more than beasts; for their excrements are ever liquid, and their flesh generally more dry: besides, they have not instruments for urine; and so all the excrementitious moisture goeth into the feathers: and therefore it is no marvel, though birds be commonly better meat than beasts, because their flesh doth assimilate more finely, and secerneth more subtilly. Again, the head of man hath hair upon the first birth, which no other part of the body hath. The cause may be want of perspiration; for much of the matter of hair, in the other parts of the

body, goeth forth by insensible perspiration; and besides, the skull being of a more solid substance, nourisheth and assimilateth less, and exerneth more; and so likewise doth the chin. We see also, that hair cometh not upon the palms of the hands, nor soles of the feet; which are parts more perspirable. And children likewise are not hairy, for that their skins are more perspirable.

Experiment solitary touching the quickness of motion in birds.

681. Birds are of swifter motion than beasts; for the flight of many birds is swifter than the race of any beasts. The cause is, for that the spirits in birds are in greater proportion, in comparison of the bulk of their body, than in beasts: for as for the reason that some give, that they are partly carried, whereas beasts go, that is nothing; for by that reason swimming should be swifter than running: and that kind of carriage also is not without labour of the wing.

Experiment solitary touching the different clearness of the sea.

682. The sea is clearer when the north wind bloweth, than when the south wind. The cause is for that salt water hath a little oiliness in the surface thereof, as appeareth in very hot days: and again, for that the southern wind relaxeth the water somewhat; and no water boiling is so clear as cold water.

Experiment solitary touching the different heats of fire and boiling water.

683. Fire burneth wood, making it first luminous; then black and brittle; and lastly, broken and incinerate; scalding water doth none of these. The cause is, for that by fire the spirit of the body is first refined, and then emitted; whereof the refining or attenuation causeth the light; and the emission, first the fragility, and after the dissolution into ashes; neither doth any other body enter: but in water the spirit of the body is not refined so much; and besides part of

the water entereth, which doth increase the spirit, and in a degree extinguisheth it: therefore we see that hot water will quench fire. And again we see, that in bodies wherein the water doth not much enter, but only the heat passeth, hot water worketh the effects of fire; as in eggs boiled and roasted, into which the water entereth not at all, there is scarce difference to be discerned; but in fruit, and flesh, whereinto the water entereth in some part, there is much more difference.

Experiment solitary touching the qualification of heat by moisture.

684. The bottom of a vessel of boiling water, as hath been observed, is not very much heated, so as men may put their hand under the vessel and remove it. The cause is, for that the moisture of water as it quencheth coals where it entereth, so it doth allay heat where it toucheth: and therefore note well, that moisture, although it doth not pass through bodies, without communication of some substance, as heat and cold do, yet it worketh manifest effects; not by entrance of the body, but by qualifying of the heat and cold; as we see in this instance: and we see, likewise, that the water of things distilled in water, which they call the bath, differeth not much from the water of things distilled by fire. We see also, that pewter dishes with water in them will not melt easily, but without it they will; nay we see more, that butter, or oil, which in themselves are inflammable, yet by virtue of their moisture will do the like.

Experiment solitary touching yawning.

685. It hath been noted by the ancients, that it is dangerous to pick one's ear whilst he yawneth. The cause is, for that in yawning the inner parchment of the ear is extended, by the drawing in of the spirit and breath; for in yawning, and sighing both, the spirit is first strongly drawn in, and then strongly expelled.

Experiment solitary touching the hiccough.

686. It hath been observed by the ancients, that sneezing doth cease the hiccough. The cause is, for that the motion of the hiccough is a lifting up of the stomach, which sneezing doth somewhat depress, and divert the motion another way. For first we see that the hiccough cometh of fulness of meat, especially in children, which causeth an extension of the stomach: we see also it is caused by acid meats, or drinks, which is by the pricking of the stomach; and this motion is ceased either by diversion, or by detention of the spirits; diversion, as in sneezing; detention, as we see holding of the breath doth help somewhat to cease the hiccough; and putting a man into an earnest study doth the like, as is commonly used: and vinegar put to the nostrils, or gargarised, doth it also; for that it is astringent, and inhibiteth the motion of the spirits.

Experiment solitary touching sneezing.

687. Looking against the sun doth induce sneezing. The cause is not the heating of the nostrils, for then the holding up of the nostrils against the sun, though one wink, would do it; but the drawing down of the moisture of the brain: for it will make the eyes run with water; and the drawing of moisture to the eyes, doth draw it to the nostrils by motion of consent; and so followeth sneezing: as contrariwise, the tickling of the nostrils within, doth draw the moisture to the nostrils, and to the eyes by consent; for they also will water. But yet it hath been observed, that if one be about to sneeze, the rubbing of the eyes till they run with water will prevent it. Whereof the cause is, for that the humour which was descending to the nostrils, is diverted to the eyes.

Experiment solitary touching the tenderness of the teeth.

688. The teeth are more by cold drink or the like, affected than the other parts. The cause is double; the one, for that the resistance of bone to cold is greater than of flesh, for that the flesh shrink-

eth, but the bone resisteth, whereby the cold becometh more eager: the other is, for that the teeth are parts without blood; whereas blood helpeth to qualify the cold; and therefore we see that the sinews are much affected with cold, for that they are parts without blood; so the bones in sharp colds wax brittle: and therefore it hath been seen, that all contusions of bones in hard weather are more difficult to cure.

Experiment solitary touching the tongue.

689. It hath been noted, that the tongue receiveth more easily tokens of diseases than the other parts; as of heats within, which appear most in the blackness of the tongue. Again, pyed cattle are spotted in their tongues, *etc.* The cause is, no doubt, the tenderness of the part, which thereby receiveth more easily all alterations, than any other parts of the flesh.

Experiment solitary touching the taste.

690. When the mouth is out of taste, it maketh things taste sometimes salt, chiefly bitter; and sometimes lothsome, but never sweet. The cause is, the corrupting of the moisture about the tongue, which many times turneth bitter, and salt, and lothsome; but sweet never; for the rest are degrees of corruption.

Experiment solitary touching some prognostics of pestilential seasons.

691. It was observed in the great plague of the last year, that there were seen in divers ditches and low grounds about London, many toads that had tails two or three inches long at the least; whereas toads usually have no tails at all. Which argueth a great disposition to putrefaction in the soil and air. It is reported likewise, that roots, such as carrots and parsnips, are more sweet and luscious in infectious years than in other years.

Experiment solitary touching special simples for medicines.

692. Wise physicians should with all diligence inquire, what simples nature yieldeth that have extreme subtile parts, without any mordication or acrimony: for they undermine that which is hard; they open that which is stopped and shut; and they expel that which is offensive, gently, without too much perturbation. Of this kind are alder-flowers; which therefore are proper for the stone: of this kind is the dwarf-pine; which is proper for the jaundice: of this kind is hartshorn; which is proper for agues and infections: of this kind is piony; which is proper for stoppings in the head: of this kind is fumitory; which is proper for the spleen: and a number of others. Generally divers creatures bred of putrefaction, though they be somewhat lothsome to take, are of this kind; as earth-worms, timber-sows, snails, *etc.* And I conceive that the trochisks of vipers, which are so much magnified, and the flesh of snakes some ways condited, and corrected, which of late are grown into some credit, are of the same nature. So the parts of beasts putrified, as *castoreum* and musk, which have extreme subtile parts, are to be placed amongst them. We see also, that putrefactions of plants, as agarick and jews-ear, are of greatest virtue. The cause is, for that putrefaction is the subtilest of all motions in the parts of bodies: and since we cannot take down the lives of living creatures, which, some of the Paracelsians say, if they could be taken down, would make us immortal; the next is for subtilty of operation, to take bodies putrified; such as may be safely taken.

Experiments in consort touching Venus.

693. It hath been observed by the ancients, that much use of Venus doth dim the sight; and yet eunuchs, which are unable to generate, are nevertheless also dim-sighted. The cause of dimness of sight in the former, is the expence of spirits; in the latter, the over-moisture of the brain: for the over-moisture of the

brain doth thicken the spirits visual, and obstructeth their passages; as we see by the decay in the sight in age; where also the diminution of the spirits concurreth as another cause: we see also that blindness cometh by rheums and cataracts. Now in eunuchs, there are all the notes of moisture; as the swelling of their thighs, the looseness of their belly, the smoothness of their skin, *etc.*

694. The pleasure in the act of Venus is the greatest of the pleasures of the senses: the matching of it with itch is improper, though that also be pleasing to the touch. But the causes are profound. First, all the organs of the senses qualify the motions of the spirits; and make so many several species of motions, and pleasures or displeasures thereupon, as there be diversities of organs. The instruments of sight, hearing taste, and smell, are of several frame; and so are the parts for generation. Therefore Scaliger doth well to make the pleasure of generation a sixth sense; and if there were any other differing organs, and qualified perforations for the spirits to pass, there would be more than the five senses: neither do we well know, whether some beasts and birds have not senses that we know not; and the very scent of dogs is almost a sense by itself. Secondly, the pleasures of the touch are greater and deeper than those of the other senses; as we see in warming upon cold; or refrigeration upon heat: for as the pains of the touch are greater than the offences of other senses; so likewise are the pleasures. It is true, that the affecting of the spirits immediately, and, as it were, without an organ, is of the greatest pleasure; which is but in two things: sweet smells, and wine, and the like sweet vapours. For smells, we see their great and sudden effect in fetching men again when they swoon: for drink, it is certain that the pleasure of drunkenness is next the pleasure of Venus; and great joys, likewise, make the spirits move and touch themselves: and the pleasure of Venus is somewhat of the same kind.

695. It hath been always observed, that men are more inclined to Venus in the winter, and women in

the summer. The cause is, for that the spirits, in a body more hot and dry, as the spirits of men are, by the summer are more exhaled and dissipated; and in the winter more condensed and kept intire: but in bodies that are cold and moist, as womens are, the summer doth cherish the spirits, and calleth them forth; the winter doth dull them. Furthermore, the abstinence, or intermission of the use of Venus in moist and well habituate bodies, breedeth a number of diseases: and especially dangerous imposthumations. The reason is evident; for that it is a principal evacuation, especially of the spirits: for of the spirits there is scarce any evacuation, but in Venus and exercise. And therefore the omission of either of them breedeth all diseases of repletion.

Experiments in consort touching the insecta.

The nature of vivification is very worthy the inquiry: and as the nature of things is commonly better perceived in small than in great; and in imperfect than in perfect; and in parts than in whole: so the nature of vivification is best inquired in creatures bred of putrefaction. The contemplation whereof hath many excellent fruits. First, in disclosing the original of vivification. Secondly, in disclosing the original of figuration. Thirdly, in disclosing many things in the nature of perfect creatures, which in them lie more hidden. And fourthly, in traducing, by way of operation, some observations in the *insecta*, to work effects upon perfect creatures. Note, that the word *insecta* agreeth not with the matter, but we ever use it for brevity's sake, intending by it creatures bred of putrefaction.

696. The *insecta* are found to breed out of several matters: some breed of mud or dung; as the earthworms, eels, snakes, *etc.* For they are both putrefactions: for water in mud doth putrify, as not able to preserve itself: and for dung, all excrements are the refuse and putrefactions of nourishment. Some breed in wood, both growing and cut down. *Query*, in what woods most, and at what seasons? We see

that the worms with many feet, which round themselves into balls, are bred chiefly under logs of timber, but not in the timber; and they are said to be found also many times in gardens, where no logs are. But it seemeth their generation requireth a coverture, both from sun, and rain or dew, as the timber is; and therefore they are not venomous, but contrariwise are held by the physicians to clarify the blood. It is observed also, that *cimices* are found in the holes of bedsides. Some breed in the hair of living creatures, as lice and tikes; which are bred by the sweat close kept, and somewhat arefied by the hair. The excrements of living creatures do not only breed *insecta* when they are excerned, but also while they are in the body; as in worms, whereto children are most subject, and are chiefly in the guts. And it hath been lately observed by physicians, that in many pestilent diseases, there are worms found in the upper parts of the body, where excrements are not, but only humours putrified. Fleas breed principally of straw or mats, where there hath been a little moisture; or the chamber and bed-straw kept close and not aired. It is received, that they are killed by strewing wormwood in the rooms. And it is truly observed, that bitter things are apt rather to kill, than engender putrefaction; and they be things that are fat or sweet that are aptest to putrify. There is a worm that breedeth in meal, of the shape of a large white maggot, which is given as a great dainty to nightingales. The moth breedeth upon cloth and other lanifices; especially if they be laid up dankish and wet. It delighteth to be about the flame of a candle. There is a worm called a wevil, bred under ground, and that feedeth upon roots; as parsnips, carrots, *etc.* Some breed in waters, especially shaded, but they must be standing waters; as the water-spider that hath six legs. The fly called the gad-fly, breedeth of somewhat that swimmeth upon the top of the water, and is most about ponds. There is a worm that breedeth of the dregs of wine decayed; which afterwards, as is observed by some of the an-

cients, turneth into a gnat. It hath been observed by the ancients, that there is a worm that breedeth in old snow, and is of colour reddish and dull of motion, and dieth soon after it cometh out of snow. Which should shew, that snow hath in it a secret warmth; for else it could hardly vivify. And the reason of the dying of the worm, may be the sudden exhaling of that little spirit, as soon as it cometh out of the cold, which had shut it in. For as butterflies quicken with heat, which were benumbed with cold; so spirits may exhale with heat, which were preserved in cold. It is affirmed both by the ancient and modern observation, that in furnaces of copper and brass, where *chalcites*, which is vitriol, is often cast in to mend the working, there riseth suddenly a fly, which sometimes moveth as if it took hold on the walls of the furnace; sometimes is seen moving in the fire below; and dieth presently as soon as it is out of the furnace: which is a noble instance, and worthy to be weighed; for it sheweth, that as well violent heat of fire, as the gentle heat of living creatures, will vivify, if it have matter proportionable. Now the great axiom of vivification is, that there must be heat to dilate the spirit of the body; an active spirit to be dilated; matter viscous or tenacious to hold in the spirit; and that matter to be put forth and figured. Now a spirit dilated by so ardent a fire as that of the furnace, as soon as ever it cooleth never so little, congealeth presently. And, no doubt, this action is furthered by the *chalcites*, which hath a spirit that will put forth and germinate, as we see in chemical trials. Briefly, most things putrified bring forth *insecta* of several names; but we will not take upon us now to enumerate them all.

697. The *insecta* have been noted by the ancients to feed little: but this hath not been diligently observed; for grasshoppers eat up the green of whole countries; and silk-worms devour leaves swiftly; and ants make great provision. It is true, that creatures that sleep and rest much, eat little; as dormice and bats, *etc.* They are all without blood: which may

be, for that the juice of their bodies is almost all one; not blood, and flesh, and skin, and bone, as in perfect creatures; the integral parts have extreme variety, but the similar parts little. It is true, that they have, some of them, a diaphragm and an intestine; and they have all skins; which in most of the *insecta* are cast often. They are not, generally of long life; yet bees have been known to live seven years: and snakes are thought, the rather for the casting of their spoil, to live till they be old: and eels, which many times breed of putrefaction, will live and grow very long: and those that interchange from worms to flies in the summer, and from flies to worms in the winter, have been kept in boxes four years at the least. Yet there are certain flies that are called *ephemera* that live but a day. The cause is the exility of the spirit, or perhaps the absence of the sun; for that if they were brought in, or kept close, they might live longer. Many of the *insecta*, as butterflies and other flies, revive easily when they seem dead, being brought to the sun or fire. The cause whereof is the diffusion of the vital spirit, and the easy dilating of it by a little heat. They stir a good while after their heads are off, or that they be cut in pieces; which is caused also, for that their vital spirits are more diffused throughout all their parts, and less confined to organs than in perfect creatures.

698. The *insecta* have voluntary motion, and therefore imagination; and whereas some of the ancients have said, that their motion is indeterminate, and their imagination indefinite, it is negligently observed; for ants go right forwards to their hills; and bees do admirably know the way from a flowery heath two or three miles off to their hives. It may be, gnats and flies have their imagination more mutable and giddy, as small birds likewise have. It is said by some of the ancients, that they have only the sense of feeling, which is manifestly untrue; for if they go forth right to a place, they must needs have sight; besides they delight more in one flower or herb than in another, and therefore have taste: and bees are

called with sound upon brass, and therefore they have hearing; which sheweth likewise, that though their spirit be diffused, yet there is a seat of their senses in their head.

Other observations concerning the *insecta*, together with the enumeration of them, we refer to that place, where we mean to handle the title of animals in general.

Experiment solitary touching leaping.

699. A man leapeth better with weights in his hands than without. The cause is, for that the weight, if it be proportionable, strengtheneth the sinews by contracting them. For otherwise, where no contraction is needful, weight hindereth. As we see in horse-races, men are curious to foresee, that there be not the least weight upon the one horse more than upon the other. In leaping with weights the arms are first cast backwards, and then forwards, with so much the greater force; for the hands go backward before they take their rise. *Query*, if the contrary motion of the spirits, immediately before the motion we intend, doth not cause the spirits as it were to break forth with more force? as breath also, drawn and kept in, cometh forth more forcibly: and in casting of any thing, the arms, to make a great swing, are first cast backward.

Experiment solitary touching the pleasures and displeasures of the senses, especially of hearing.

700. Of musical tones and unequal sounds we have spoken before; but touching the pleasure and displeasure of the senses, not so fully. Harsh sounds, as of a saw when it is sharpened; grinding of one stone against another; squeaking or shrieking noise; make a shivering or horror in the body, and set the teeth on edge. The cause is, for that the objects of the ear do affect the spirits, immediately, most with pleasure and offence. We see there is no colour that affecteth the eye much with displeasure: there be sights that are horrible, because they excite the memory of things

that are odious or fearful; but the same things painted do little affect. As for smells, tastes, and touches, they be things that do affect by a participation or impulsion of the body of the object. So it is sound alone that doth immediately and incorporeally affect most; this is most manifest in music, and concords and discords in music: for all sounds, whether they be sharp or flat, if they be sweet, have a roundness and equality; and if they be harsh, are unequal: for a discord itself is but a harshness of divers sounds meeting. It is true that inequality not stayed upon, but passing, is rather an increase of sweetness; as in the purling of a wreathed string; and in the raucity of a trumpet; and in the nightingale-pipe of a regal; and in a discord straight falling upon a concord; but if you stay upon it, it is offensive: and therefore there be these three degrees of pleasing and displeasing in sounds, sweet sounds, discords, and harsh sounds, which we call by divers names, as shrieking or grating, such as we now speak of. As for the setting of the teeth on edge, we see plainly what an intercourse there is between the teeth and the organ of the hearing, by the taking of the end of a bow between the teeth, and striking upon the string.

NATURAL HISTORY.

CENTURY VIII.

Experiment solitary touching veins of medicinal earth.

701. THERE be minerals and fossils in great variety; but of veins of earth medicinal, but few: the chief are *terra lemnia*, *terra sigillata communis*, and *bolus armenus*; whereof *terra lemnia* is the chief. The virtues of them are, for curing of wounds, stanching of blood, stopping of fluxes, and rheums, and arresting the spreading of poison, infection, and putrefaction: and they have of all other simples the perfectest and purest quality of drying, with little or no mixture of any other quality. Yet it is true, that the bole-armoniac is the most cold of them, and that *terra lemnia* is the most hot; for which cause the island Lemnos, where it is digged, was in the old fabulous ages consecrated to Vulcan.

Experiment solitary touching the growth of sponges.

702. ABOUT the bottom of the Straits are gathered great quantities of sponges, which are gathered from the sides of rocks, being as it were a large but tough moss. It is the more to be noted, because that there be but few substances, plant-like, that grow deep within the sea; for they are gathered sometimes fifteen fathom deep: and when they are laid on shore, they seem to be of great bulk; but crushed together, will be transported in a very small room.

Experiment solitary touching sea-fish put in fresh waters.

703. IT seemeth, that fish that are used to the salt water, do nevertheless delight more in fresh. We see, that salmons and smelts love to get into rivers,

though it be against the stream. At the haven of Constantinople you shall have great quantities of fish that come from the Euxine sea, that when they come into the fresh water, do inebriate and turn up their bellies, so as you may take them with your hand. I doubt there hath not been sufficient experiment made of putting sea-fish into fresh water, ponds, and pools. It is a thing of great use and pleasure; for so you may have them new at some good distance from the sea: and besides, it may be, the fish will eat the pleasanter, and may fall to breed. And it is said, that Colchester oisters, which are put into pits, where the sea goeth and cometh, but yet so that there is a fresh water coming also to them when the sea voideth, become by that means fatter, and more grown.

Experiment solitary touching attraction by similitude of substance.

704. The Turkish bow giveth a very forcible shoot; insomuch as it hath been known, that the arrow hath pierced a steel target, or a piece of brass of two inches thick: but that which is more strange, the arrow, if it be headed with wood, hath been known to pierce through a piece of wood of eight inches thick. And it is certain, that we had in use at one time, for sea fight, short arrows, which they called sprights, without any other heads, save wood sharpened; which were discharged out of muskets, and would pierce through the sides of ships where a bullet would not pierce. But this dependeth upon one of the greatest secrets in all nature; which is, that similitude of substance will cause attraction, where the body is wholly freed from the motion of gravity: for if that were taken away, lead would draw lead, and gold would draw gold, and iron would draw iron, without the help of the loadstone. But this same motion of weight or gravity, which is a mere motion of the matter, and hath no affinity with the form or kind, doth kill the other motion, except itself be killed by a violent motion, as in these instances of arrows; for then the motion of attraction by similitude of substance beginneth

to shew itself. But we shall handle this point of nature fully in due place.

Experiment solitary touching certain drinks in Turkey.

705. They have in Turkey and the east certain confections, which they call servets, which are like to candied conserves, and are made of sugar and lemons, or sugar and citrons, or sugar and violets, and some other flowers; and some mixture of amber for the more delicate persons: and those they dissolve in water, and thereof make their drink, because they are forbidden wine by their law. But I do much marvel, that no Englishman, or Dutchman, or German, doth set up brewing in Constantinople; considering they have such quantity of barley. For as for the general sort of men, frugality may be the cause of drinking water; for that it is no small saving to pay nothing for one's drink; but the better sort might well be at the cost. And yet I wonder the less at it, because I see France, Italy, or Spain, have not taken into use beer or ale; which, perhaps, if they did, would better both their healths and their complexions. It is likely it would be matter of great gain to any that should begin it in Turkey.

Experiments in consort touching sweat.

706. In bathing in hot water, sweat, nevertheless, cometh not in the parts under the water. The cause is; first, for that sweat is a kind of colliquation, and that kind of colliquation is not made either by an over-dry heat, or an over-moist heat: for over-moisture doth somewhat extinguish the heat, as we see that even hot water quencheth fire; and over-dry heat shutteth the pores: and therefore men will sooner sweat covered before the sun or fire, than if they stood naked: and earthen bottles, filled with hot water, do provoke in bed a sweat more daintily than brick-bats hot. Secondly, hot water doth cause evaporation from the skin; so as it spendeth the matter in those parts under the water, before it issueth in sweat. Again, sweat cometh more plentifully, if the heat be

increased by degrees, than if it be greatest at first or equal. The cause is, for that the pores are better opened by a gentle heat, than by a more violent; and by their opening, the sweat issueth more abundantly. And therefore physicians may do well when they provoke sweat in bed by bottles, with a decoction of sudorific herbs in hot water, to make two degrees of heat in the bottles; and to lay in the bed the less heated first, and after half an hour, the more heated.

707. Sweat is salt in taste; the cause is, for that that part of the nourishment which is fresh and sweet, turneth into blood and flesh; and the sweat is only that part which is separate and excerned. Blood also raw hath some saltness more than flesh: because the assimilation into flesh is not without a little and subtile excretion from the blood.

708. Sweat cometh forth more out of the upper parts of the body than the lower; the reason is, because those parts are more replenished with spirits; and the spirits are they that put forth sweat: besides, they are less fleshy, and sweat issueth, chiefly, out of the parts that are less fleshy, and more dry; as the forehead and breast.

709. Men sweat more in sleep than waking; and yet sleep doth rather stay other fluxions, than cause them; as rheums, looseness of the body, *etc.* The cause is, for that in sleep the heat and spirits do naturally move inwards, and there rest. But when they are collected once within, the heat becometh more violent and irritate; and thereby expelleth sweat.

710. Cold sweats are, many times, mortal, and near death; and always ill, and suspected; as in great fears, hypochondriacal passions, *etc.* The cause is, for that cold sweats come by a relaxation or forsaking of the spirits, whereby the moisture of the body, which heat did keep firm in the parts, severeth and issueth out.

711. In those diseases which cannot be discharged by sweat, sweat is ill, and rather to be stayed; as in diseases of the lungs, and fluxes of the belly: but in those diseases which are expelled by sweat, it easeth

and lighteneth; as in agues, pestilences, *etc.* The cause is, for that sweat in the latter sort is partly critical, and sendeth forth the matter that offendeth; but in the former, it either proceedeth from the labour of the spirits, which sheweth them oppressed; or from motion of consent, when nature, not able to expel the disease where it is seated, moveth to an expulsion indifferent over all the body.

Experiment solitary touching the glow-worm.

712. The nature of the glow-worm is hitherto not well observed. Thus much we see; that they breed chiefly in the hottest months of summer; and that they breed not in champain, but in bushes and hedges. Whereby it may be conceived, that the spirit of them is very fine, and not to be refined but by summer heats: and again, that by reason of the fineness, it doth easily exhale. In Italy, and the hotter countries, there is a fly they call *Lucciole*, that shineth as the glow-worm doth; and it may be is the flying glow-worm. But that fly is chiefly upon fens and marshes. But yet the two former observations hold; for they are not seen but in the heat of summer; and sedge, or other green of the fens, give as good shade as bushes. It may be the glow-worms of the cold countries ripen not so far as to be winged.

Experiments in consort touching the impressions, which the passions of the mind make upon the body.

713. The passions of the mind work upon the body the impressions following. Fear causeth paleness, trembling, the standing of the hair upright, starting and shrieking. The paleness is caused, for that the blood runneth inward to succour the heart. The trembling is caused, for that through the flight of the spirits inward, the outward parts are destituted, and not sustained. Standing upright of the hair is caused, for that by the shutting of the pores of the skin, the hair that lieth aslope must needs rise. Starting is both an apprehension of the thing feared, and in that kind it is a motion of shrinking, and likewise an inquisition

in the beginning, what the matter should be, and in that kind it is a motion of erection, and therefore when a man would listen suddenly to any thing, he starteth; for the starting is an erection of the spirits to attend. Shrieking is an appetite of expelling that which suddenly striketh the spirits: for it must be noted, that many motions, though they be unprofitable to expel that which hurteth, yet they are offers of nature, and cause motions by consent; as in groaning, or crying upon pain.

714. Grief and pain cause sighing, sobbing, groaning, screaming, and roaring; tears, distorting of the face, grinding of the teeth, sweating. Sighing is caused by the drawing in of a greater quantity of breath to refresh the heart that laboureth; like a great draught when one is thirsty. Sobbing is the same thing stronger. Groaning and screaming, and roaring, are caused by an appetite of expulsion, as hath been said: for when the spirits cannot expel the thing that hurteth, in their strife to do it by motion of consent, they expel the voice. And this is when the spirits yield, and give over to resist: for if one do constantly resist pain, he will not groan. Tears are caused by a contraction of the spirits of the brain; which contraction by consequence astringeth the moisture of the brain, and thereby sendeth tears into the eyes. And this contraction or compression causeth also wringing of the hands; for wringing is a gesture of expression of moisture. The distorting of the face is caused by a contention, first to bear and resist, and then to expel; which maketh the parts knit first, and afterwards open. Grinding of the teeth is caused, likewise, by a gathering and serring of the spirits together to resist, which maketh the teeth also to sit hard one against another. Sweating is also a compound motion, by the labour of the spirits, first to resist, and then to expel.

715. Joy causeth a cheerfulness and vigour in the eyes, singing, leaping, dancing, and sometimes tears. All these are the effects of the dilatation and coming forth of the spirits into the outward parts; which

maketh them more lively and stirring. We know it hath been seen, that excessive sudden joy hath caused present death, while the spirits did spread so much as they could not retire again. As for tears, they are the effects of compression of the moisture of the brain, upon dilatation of the spirits. For compression of the spirits worketh an expression of the moisture of the brain by consent, as hath been said in grief. But then in joy, it worketh it diversly; namely, by propulsion of the moisture, when the spirits dilate, and occupy more room.

716. Anger causeth paleness in some, and the going and coming of the colour in others: also trembling in some; swelling, foaming at the mouth, stamping, bending of the fist. Paleness, and going and coming of the colour, are caused by the burning of the spirits about the heart; which to refresh themselves, call in more spirits from the outward parts. And if the paleness be alone, without sending forth the colour again, it is commonly joined with some fear; but in many there is no paleness at all, but contrariwise redness about the cheeks and gills; which is by the sending forth of the spirits in an appetite to revenge. Trembling in anger is likewise by a calling in of the spirits; and is commonly when anger is joined with fear. Swelling is caused, both by a dilatation of the spirits by over-heating, and by a liquefaction or boiling of the humours thereupon. Foaming at the mouth is from the same cause, being an ebullition. Stamping, and bending of the fist, are caused by an imagination of the act of revenge.

717. Light displeasure or dislike causeth shaking of the head, frowning and knitting of the brows. These effects arise from the same causes that trembling and horror do; namely, from the retiring of the spirits, but in a less degree. For the shaking of the head is but a slow and definite trembling; and is a gesture of slight refusal; and we see also, that a dislike causeth, often, that gesture of the hand, which we use when we refuse a thing, or warn it away. The frowning and knitting of the brows is a gathering, or

serring of the spirits, to resist in some measure. And we see also this knitting of the brows will follow upon earnest studying, or cogitation of any thing, though it be without dislike.

718. Shame causeth blushing, and casting down of the eyes. Blushing is the resort of blood to the face; which in the passion of shame is the part that laboureth most. And although the blushing will be seen in the whole breast if it be naked, yet that is but in passage to the face. As for the casting down of the eyes, it proceedeth of the reverence a man beareth to other men; whereby, when he is ashamed, he cannot indure to look firmly upon others: and we see, that blushing, and the casting down of the eyes both, are more when we come before many; *ore Pompeii quid mollius? nunquam non coram pluribus erubuit:* and likewise when we come before great or reverend persons.

719. Pity causeth sometimes tears; and a flexion or cast of the eye aside. Tears come from the same cause that they do in grief: for pity is but grief in another's behalf. The cast of the eye is a gesture of aversion, or lothness to behold the object of pity.

720. Wonder causeth astonishment, or an immoveable posture of the body; casting up of the eyes to heaven, and lifting up of the hands. For astonishment, it is caused by the fixing of the mind upon one object of cogitation, whereby it doth not spatiate and transcur, as it useth; for in wonder the spirits fly not, as in fear; but only settle, and are made less apt to move. As for the casting up of the eyes, and lifting up of the hands, it is a kind of appeal to the Deity, which is the author, by power and providence, of strange wonders.

721. Laughing causeth a dilatation of the mouth and lips; a continued expulsion of the breath, with the loud noise, which maketh the interjection of laughing; shaking of the breasts and sides; running of the eyes with water, if it be violent and continued. Wherein first it is to be understood, that laughing is scarce, properly, a passion, but hath its source from

the intellect; for in laughing there ever precedeth a conceit of somewhat ridiculous. And therefore it is proper to man. Secondly, that the cause of laughing is but a light touch of the spirits, and not so deep an impression as in other passions. And therefore, that which hath no affinity with the passions of the mind, it is moved, and that in great vehemency, only by tickling some parts of the body: and we see that men even in a grieved state of mind, yet cannot sometimes forbear laughing. Thirdly, it is ever joined with some degree of delight: and therefore exhilaration hath some affinity with joy, though it be a much lighter motion: *res severa est verum gaudium.* Fourthly, that the object of it is deformity, absurdity, shrewd turns, and the like. Now to speak of the causes of the effects before mentioned, whereunto these general notes give some light. For the dilatation of the mouth and lips, continued expulsion of the breath and voice, and shaking of the breast and sides, they proceed, all, from the dilatation of the spirits; especially being sudden. So likewise, the running of the eyes with water, as hath been formerly touched, where we spake of the tears of joy and grief, is an effect of dilatation of the spirits. And for suddenness, it is a great part of the matter: for we see, that any shrewd turn that lighteth upon another; or any deformity, *etc.* moveth laughter in the instant; which after a little time it doth not. So we cannot laugh at any thing after it is stale, but whilst it is new: and even in tickling, if you tickle the sides, and give warning; or give a hard or continued touch, it doth not move laughter so much.

722. Lust causeth a flagrancy in the eyes and priapism. The cause of both these is, for that in lust, the sight and the touch are the things desired; and therefore the spirits resort to those parts which are most affected. And note well in general, for that great use may be made of the observation, that, evermore, the spirits, in all passions, resort most to the parts that labour most, or are most affected. As in the last which hath been mentioned, they resort to the eyes

and venereous parts: in fear and anger to the heart: in shame to the face: and in light dislikes to the head.

Experiments in consort touching drunkenness.

723. It hath been observed by the ancients, and is yet believed, that the sperm of drunken men is unfruitful. The cause is, for that it is over-moistened, and wanteth spissitude: and we have a merry saying, that they that go drunk to bed get daughters.

724. Drunken men are taken with a plain defect, or destitution in voluntary motion. They reel; they tremble; they cannot stand, nor speak strongly. The cause is, for that the spirits of the wine oppress the spirits animal, and occupy part of the place where they are; and so make them weak to move. And therefore drunken men are apt to fall asleep: and opiates, and stupefactives, as poppy, hen-bane, hemlock, *etc.* induce a kind of drunkenness, by the grossness of their vapour; as wine doth by the quantity of the vapour. Besides, they rob the spirits animal of their matter whereby they are nourished: for the spirits of the wine prey upon it as well as they: and so they make the spirits less supple and apt to move.

725. Drunken men imagine every thing turneth round; they imagine also that things come upon them; they see not well things afar off; those things that they see near hand, they see out of their place; and sometimes they see things double. The cause of the imagination that things turn round is, for that the spirits themselves turn, being compressed by the vapour of the wine, for any liquid body upon compression turneth, as we see in water, and it is all one to the sight, whether the visual spirits move, or the object moveth, or the medium moveth. And we see that long turning round breedeth the same imagination. The cause of the imagination that things come upon them is, for that the spirits visual themselves draw back; which maketh the object seem to come on; and besides, when they see things turn round and

move, fear maketh them think they come upon them. The cause that they cannot see things afar off, is the weakness of the spirits; for in every megrim or vertigo there is an obtenebration joined with a semblance of turning round; which we see also in the lighter sort of swoonings. The cause of seeing things out of their place, is the refraction of the spirits visual; for the vapour is as an unequal medium; and it is as the sight of things out of place in water. The cause of seeing things double is the swift and unquiet motion of the spirits, being oppressed, to and fro; for, as was said before, the motion of the spirits visual, and the motion of the object, make the same appearances; and for the swift motion of the object, we see, that if you fillip a lute-string it sheweth double or treble.

726. Men are sooner drunk with small draughts than with great. And again, wine sugared inebriateth less than wine pure. The cause of the former is, for that the wine descendeth not so fast to the bottom of the stomach, but maketh longer stay in the upper part of the stomach, and sendeth vapours faster to the head; and therefore inebriateth sooner. And for the same reason, sops in wine, quantity for quantity, inebriate more than wine of itself. The cause of the latter is, for that the sugar doth inspissate the spirits of the wine, and maketh them not so easy to resolve into vapour. Nay farther, it is thought to be some remedy against inebriating, if wine sugared be taken after wine pure. And the same effect is wrought either by oil or milk, taken upon much drinking.

Experiment solitary touching the help or hurt of wine, though moderately used.

727. The use of wine in dry and consumed bodies is hurtful; in moist and full bodies it is good. The cause is, for that the spirits of the wine do prey upon the dew or radical moisture, as they term it, of the body, and so deceive the animal spirits. But where there is moisture enough, or superfluous, there wine helpeth to digest, and desiccate the moisture.

Experiment solitary touching caterpillars.

728. The caterpillar is one of the most general of worms, and breedeth of dew and leaves; for we see infinite number of caterpillars which breed upon trees and hedges, by which the leaves of the trees or hedges are in great part consumed; as well by their breeding out of the leaf, as by their feeding upon the leaf. They breed in the spring chiefly, because then there is both dew and leaf. And they breed commonly when the east winds have much blown; the cause whereof is, the dryness of that wind; for to all vivification upon putrefaction, it is requisite the matter be not too moist: and therefore we see they have cobwebs about them, which is a sign of a slimy dryness; as we see upon the ground, whereupon by dew and sun cobwebs breed all over. We see also the green caterpillar breedeth in the inward parts of roses, especially not blown, where the dew sticketh; but especially caterpillars, both the greatest, and the most, breed upon cabbages, which have a fat leaf, and apt to putrify. The caterpillar, towards the end of summer, waxeth volatile, and turneth to a butterfly, or perhaps some other fly. There is a caterpillar that hath a fur or down upon it, and seemeth to have affinity with the silk-worm.

Experiment solitary touching the flies cantharides.

729. The flies *cantharides* are bred of a worm or caterpillar, but peculiar to certain fruit-trees; as are the fig-tree, the pine-tree, and the wild brier; all which bear sweet fruit, and fruit that hath a kind of secret biting or sharpness: for the fig hath a milk in it that is sweet and corrosive; the pine-apple hath a kernel that is strong and abstersive: the fruit of the brier is said to make children, or those that eat them, scabbed. And therefore no marvel, though *cantharides* have such a corrosive and cauterising quality; for there is not any other of the *insecta*, but is bred of a duller matter. The body of the *cantharides* is bright coloured; and it may be, that the delicate coloured dragon-flies may have likewise some corrosive quality.

Experiments in consort touching lassitude.

730. Lassitude is remedied by bathing, or anointing with oil and warm water. The cause is, for that all lassitude is a kind of contusion, and compression of the parts; and bathing and anointing give a relaxation or emollition; and the mixture of oil and water is better than either of them alone; because water entereth better into the pores, and oil after entry softeneth better. It is found also, that the taking of tobacco doth help and discharge lassitude. The reason whereof is, partly, because by cheering or comforting of the spirits, it openeth the parts compressed or contused; and chiefly because it refresheth the spirits by the opiate virtue thereof, and so dischargeth weariness, as sleep likewise doth.

731. In going up a hill, the knees will be most weary; in going down a hill, the thighs. The cause is, for that in the lift of the feet, when a man goeth up the hill, the weight of the body beareth most upon the knees; and in going down the hill, upon the thighs.

Experiment solitary touching the casting of the skin and shell in some creatures.

732. The casting of the skin is by the ancients compared to the breaking of the secundine, or caul, but not rightly: for that were to make every casting of the skin a new birth: and besides the secundine is but a general cover, not shaped according to the parts, but the skin is shaped according to the parts. The creatures that cast their skin are, the snake, the viper, the grasshopper, the lizard, the silk-worm, *etc.* Those that cast their shell are, the lobster, the crab, the crawfish, the hodmandod or dodman, the tortoise, *etc.* The old skins are found, but the old shells never: so as it is like, they scale off, and crumble away by degrees. And they are known by the extreme tenderness and softness of the new shell, and sometimes by the freshness of the colour of it. The cause of the casting of skin and shell should seem to be the great

quantity of matter in those creatures that is fit to make skin or shell: and again, the looseness of the skin or shell, that sticketh not close to the fish. For it is certain, that it is the new skin or shell that putteth off the the old: so we see, that in deer it is the young horn that putteth off the old; and in birds, the young feathers put off the old: and so birds that have much matter for their beak, cast their beaks, the new beak puting off the old.

Experiments in consort touching the postures of the body.

733. Lying not erect, but hollow, which is in the making of the bed; or with the legs gathered up, which is in the posture of the body, is the more wholesome. The reason is, the better comforting of the stomach, which is by that less pensile: and we see that in weak stomachs, the laying up of the legs high, and the knees almost to the mouth, helpeth and comforteth. We see also, that galley-slaves, notwithstanding their misery otherwise, are commonly fat and fleshy; and the reason is, because the stomach is supported somewhat in sitting, and is pensile in standing or going. And therefore, for prolongation of life, it is good to choose those exercises where the limbs move more than the stomach and belly; as in rowing, and in sawing being set.

734. Megrims and giddiness are rather when we rise after long sitting, than while we sit. The cause is, for that the vapours, which were gathered by sitting, by the sudden motion fly more up into the head.

735. Leaning long upon any part maketh it numb, and as we call it asleep. The cause is, for that the compression of the part suffereth not the spirits to have free access; and therefore when we come out of it, we feel a stinging or pricking, which is the reentrance of the spirits.

Experiment solitary touching pestilential years.

736. It hath been noted, that those years are pestilential and unwholsome, when there are great

numbers of frogs, flies, locusts, *etc.* The cause is plain; for that those creatures being engendered of putrefaction, when they abound, shew a general disposition of the year, and constitution of the air, to diseases of putrefaction. And the same prognostic, as hath been said before, holdeth, if you find worms in oak-apples: for the constitution of the air appeareth more subtilly in any of these things, than to the sense of man.

Experiment solitary touching the prognostics of hard winters.

737. It is an observation amongst country people, that years of store of haws and hips do commonly portend cold winters; and they ascribe it to God's providence, that, as the Scripture saith, reacheth even the falling of a sparrow; and much more is like to reach to the preservation of birds in such seasons. The natural cause also may be the want of heat, and abundance of moisture, in the summer precedent; which putteth forth those fruits, and must needs leave great quantity of cold vapours not dissipated; which causeth the cold of the winter following.

Experiment solitary touching medicines that condense and relieve the spirits.

738. They have in Turkey a drink called coffee, made of a berry of the same name, as black as soot, and of a strong scent, but not aromatical; which they take, beaten into powder, in water, as hot as they can drink it; and they take it, and sit at it in their coffee-houses, which are like our taverns. This drink comforteth the brain and heart, and helpeth digestion. Certainly this berry coffee, the root and leaf beetle, the leaf tobacco, and the tear of poppy, *opium*, of which the Turks are great takers, supposing it expelleth all fear, do all condense the spirits, and make them stronger and aleger. But it seemeth they are taken after several manners; for coffee and *opium* are taken down, tobacco but in smoke, and beetle is but champed in the mouth with a little lime. It is like

there are more of them, if they were well found out, and well corrected. *Query*, of henbane-seed; of mandrake; of saffron, root and flower; of *folium indicum*; of ambergrease; of the *Assyrian amomum*, if it may be had; and of the scarlet powder which they call *kermes*; and, generally, of all such things as do inebriate and provoke sleep. Note, that tobacco is not taken in root or seed, which are more forcible ever than leaves.

Experiment solitary touching paintings of the body.

739. The Turks have a black powder, made of a mineral called alcohol, which with a fine long pencil they lay under their eye-lids, which doth colour them black; whereby the white of the eye is set off more white. With the same powder they colour also the hairs of their eye-lids, and of their eye-brows, which they draw into embowed arches. You shall find that Xenophon maketh mention, that the Medes used to paint their eyes. The Turks use with the same tincture to colour the hair of their heads and beards black. And divers with us that are grown grey, and yet would appear young, find means to make their hair black, by combing it, as they say, with a leaden comb, or the like. As for the Chinese, who are of an ill complexion, being olivaster, they paint their cheeks scarlet, especially their king and grandees. Generally, barbarous people, that go naked, do not only paint themselves, but they pounce and raise their skin, that the painting may not be taken forth; and make it into works. So do the West Indians; and so did the ancient Picts and Britons; so that it seemeth men would have the colours of birds feathers, if they could tell how; or at least they will have gay skins instead of gay clothes.

Experiment solitary touching the use of bathing and anointing.

740. It is strange, that the use of bathing, as a part of diet, is left. With the Romans and Grecians it was as usual as eating or sleeping; and so is it

amongst the Turks at this day; whereas with us it remaineth but as a part of physic. I am of opinion, that the use of it, as it was with the Romans, was hurtful to health; for that it made the body soft and easy to waste. For the Turks it is more proper, because that their drinking water and feeding upon rice and other food of small nourishment, maketh their bodies so solid and hard, as you need not fear that bathing should make them frothy. Besides, the Turks are great sitters, and seldom walk, whereby they sweat less, and need bathing more. But yet certain it is that bathing, and especially anointing, may be so used as it may be a great help to health, and prolongation of life. But hereof we shall speak in due place, when we come to handle experiments medicinal.

Experiment solitary touching cambleting of paper.

741. The Turks have a pretty art of cambleting of paper, which is not with us in use. They take divers oiled colours, and put them severally, in drops, upon water, and stir the water lightly, and then wet their paper, being of some thickness, with it, and the paper will be waved and veined, like camblet or marble.

Experiment solitary touching cuttle-ink.

742. It is somewhat strange, that the blood of all birds and beasts and fishes should be of a red colour, and only the blood of the cuttle should be as black as ink. A man would think, that the cause should be the high concoction of that blood; for we see in ordinary puddings, that the boiling turneth the blood to be black; and the cuttle is accounted a delicate meat, and is much in request.

Experiment solitary touching increase of weight in earth.

743. It is reported of credit, that if you take earth from land adjoining to the river of Nile, and preserve it in that manner that it neither come to be wet nor wasted; and weigh it daily, it will not alter weight until the seventeenth of June, which is the day when the

river beginneth to rise; and then it will grow more and more ponderous, till the river cometh to its height. Which if it be true, it cannot be caused but by the air, which then beginneth to condense; and so turneth within that small mold into a degree of moisture, which produceth weight. So it hath been observed, that tobacco cut, and weighed, and then dried by the fire, loseth weight; and after being laid in the open air, recovereth weight again. And it should seem, that as soon as ever the river beginneth to increase, the whole body of the air thereabouts suffereth a change: for, that which is more strange, it is credibly affirmed, that upon that very day when the river first riseth, great plagues in Cairo use suddenly to break up.

Experiments in consort touching sleep.

744. Those that are very cold, and especially in their feet, cannot get to sleep: the cause may be, for that in sleep is required a free respiration, which cold doth shut in and hinder; for we see that in great colds, one can scarce draw his breath. Another cause may be, for that cold calleth the spirits to succour; and therefore they cannot so well close, and go together in the head; which is ever requisite to sleep. And for the same cause, pain and noise hinder sleep; and darkness, contrariwise, furthereth sleep.

745. Some noises, whereof we spake in the hundred and twelfth experiment, help sleep: as the blowing of the wind, the trickling of water, humming of bees, soft singing, reading, *etc.* The cause is, for that they move in the spirits a gentle attention; and whatsoever moveth attention without too much labour stilleth the natural and discursive motion of the spirits.

746. Sleep nourisheth, or at least preserveth bodies a long time, without other nourishment. Beasts that sleep in the winter, as it is noted of wild bears, during their sleep wax very fat, though they eat nothing. Bats have been found in ovens, and other hollow close places, matted one upon another: and therefore it is likely that they sleep in the winter time, and eat nothing. *Query*, whether bees do not sleep

all winter, and spare their honey? Butterflies, and other flies, do not only sleep, but lie as dead all winter; and yet with a little heat of sun or fire, revive again. A dormouse, both winter and summer, will sleep some days together, and eat nothing.

Experiments in consort touching teeth and hard substances in the bodies of living creatures.

To restore teeth in age, were *magnale naturæ*. It may be thought of. But howsoever, the nature of the teeth deserveth to be inquired of, as well as the other parts of living creatures bodies.

747. There be five parts in the bodies of living creatures, that are of hard substance; the skull, the the teeth, the bones, the horns, and the nails. The greatest quantity of hard substance continued, is towards the head. For there is the skull of one intire bone; there are the teeth; there are the maxillary bones; there is the hard bone that is the instrument of hearing; and thence issue the horns: so that the building of living creatures bodies is like the building of a timber house, where the walls and other parts have columns and beams; but the roof is, in the better sort of houses, all tile, or lead, or stone. As for birds, they have three other hard substances proper to them; the bill, which is of like matter with the teeth; for no birds have teeth: the shell of the egg: and their quills: for as for their spur, it is but a nail. But no living creatures, that have shells very hard, as oisters, cockles, muscles, scallops, crabs, lobsters, craw-fish, shrimps, and especially the tortoise, have bones within them, but only little gristles.

748. Bones, after full growth, continue at a stay; and so doth the skull: horns, in some creatures, are cast and renewed: teeth stand at a stay, except their wearing: as for nails, they grow continually: and bills and beaks will overgrow, and sometimes be cast; as in eagles and parrots.

749. Most of the hard substances fly to the extremes of the body: as skull, horns, teeth, nails, and beaks: only the bones are more inward, and clad with

flesh. As for the entrails, they are all without bones; save that a bone is, sometimes, found in the heart of a stag; and it may be in some other creature.

750. The skull hath brains, as a kind of marrow, within it. The back-bone hath one kind of marrow, which hath an affinity with the brain; and other bones of the body have another. The jaw-bones have no marrow severed, but a little pulp of marrow diffused. Teeth likewise are thought to have a kind of marrow diffused, which causeth the sense of pain; but it is rather sinew; for marrow hath no sense; no more than blood. Horn is alike throughout; and so is the nail.

751. None other of the hard substances have sense, but the teeth; and the teeth have sense, not only of pain but of cold.

But we will leave the inquiries of other hard substances to their several places; and now inquire only of the teeth.

752. The teeth are, in men, of three kinds: sharp, as the fore-teeth: broad, as the back-teeth, which we call the molar-teeth, or grinders; and pointed teeth, or canine, which are between both. But there have been some men, that have had their teeth undivided, as of one whole bone, with some little mark in the place of the division; as Pyrrhus had. Some creatures have over-long or out-growing teeth, which we call fangs, or tusks: as boars, pikes, salmons, and dogs, though less. Some living creatures have teeth against teeth; as men and horses; and some have teeth, especially their master-teeth, indented one within another like saws, as lions; and so again have dogs. Some fishes have divers rows of teeth in the roofs of their mouths; as pikes, salmons, trouts, *etc.* And many more in salt waters. Snakes, and other serpents, have venomous teeth; which are sometimes mistaken for their sting.

753. No beast that hath horns hath upper teeth; and no beast that hath teeth above wanteth them below: but yet if they be of the same kind, it followeth not, that if the hard matter goeth not into upper teeth,

it will go into horns; nor yet *e converso*; for does, that have no horns, have no upper teeth.

754. Horses have, at three years old, a tooth put forth, which they call the colt's tooth; and at four years old there cometh the mark tooth, which hath a hole as big as you may lay a pea within it; and that weareth shorter and shorter every year; till that at eight years old the tooth is smooth, and the hole gone; and then they say, that the mark is out of the horse's mouth.

755. The teeth of men breed first, when the child is about a year and half old: and then they cast them, and new come about seven years old. But divers have backward teeth come forth at twenty, yea some at thirty and forty. *Query*, of the manner of the coming of them forth. They tell a tale of the old Countess of Desmond, who lived till she was sevenscore years old, that she did dentite twice or thrice; casting her old teeth, and others coming in their place.

756. Teeth are much hurt by sweetmeats; and by painting with mercury; and by things overhot; and by things over-cold; and by rheums. And the pain of the teeth is one of the sharpest of pains.

757. Concerning teeth, these things are to be considered. 1. The preserving of them. 2. The keeping of them white. 3. The drawing of them with least pain. 4. The staying and easing of the tooth-ach. 5. The binding in of artificial teeth, where teeth have been strucken out. 6. And last of all, that great one of restoring teeth in age. The instances that give any likelihood of restoring teeth in age, are the late coming of teeth in some; and the renewing of the beaks in birds, which are commaterial with teeth. *Query*, therefore, more particularly how that cometh. And again, the renewing of horns. But yet that hath not been known to have been provoked by art; therefore let trial be made, whether horns may be procured to grow in beasts that are not horned, and how? And whether they may be procured to come larger than usual; as to make an ox or a deer have a greater head of horns? And whether

the head of a deer, that by age is more spitted, may be brought again to be more branched? for these trials, and the like, will shew, whether by art such hard matter can be called and provoked. It may be tried, also, whether birds may not have something done to them when they are young, whereby they may be made to have greater or longer bills; or greater and longer talons? And whether children may not have some wash, or something to make their teeth better and stronger? Coral is in use as an help to the teeth of children.

Experiments in consort touching the generation and bearing of living creatures in the womb.

758. Some living creatures generate but at certain seasons of the year; as deer, sheep, wild conies, *etc.* and most sorts of birds and fishes: others at any time of the year, as men; and all domestic creatures, as horses, hogs, dogs, cats, *etc.* The cause of generation at all seasons seemeth to be fulness: for generation is from redundance. This fulness ariseth from two causes; either from the nature of the creature, if it be hot, and moist, and sanguine; or from plenty of food. For the first, men, horses, dogs, *etc.* which breed at all seasons, are full of heat and moisture; doves are the fullest of heat and moisture amongst birds, and therefore breed often; the tame dove almost continually. But deer are a melancholy dry creature, as appeareth by their fearfulness, and the hardness of their flesh. Sheep are a cold creature, as appeareth by their mildness, and for that they seldom drink. Most sort of birds are of a dry substance in comparison of beasts. Fishes are cold. For the second cause, fulness of food; men, kine, swine, dogs, *etc.* feed full; and we see that those creatures, which being wild, generate seldom, being tame, generate often; which is from warmth, and fulness of food. We find, that the time of going to rut of deer is in September; for that they need the whole summer's feed and grass to make them fit for generation. And if rain come early about the middle of September,

they go to rut somewhat the sooner; if drought, somewhat the later. So sheep, in respect of their small heat, generate about the same time, or somewhat before. But for the most part, creatures that generate at certain seasons, generate in the spring: as birds and fishes; for that the end of the winter, and the heat and comfort of the spring prepareth them. There is also another reason, why some creatures generate at certain seasons; and that is the relation of their time of bearing, to the time of generation; for no creature goeth to generate whilst the female is full; nor whilst she is busy in sitting, or rearing her young. And therefore it is found by experience, that if you take the eggs or young ones, out of the nests of birds, they will fall to generate again three or four times one after another.

759. Of living creatures, some are longer time in the womb, and some shorter. Women go commonly nine months; the cow and the ewe about six months; does go about nine months; mares eleven months: bitches nine weeks; elephants are said to go two years; for the received tradition of ten years is fabulous. For birds there is double inquiry; the distance between the treading or coupling, and the laying of the egg; and again, between the egg laid, and the disclosing or hatching. And amongst birds, there is less diversity of time, than amongst other creatures; yet some there is; for the hen sitteth but three weeks, the turkey-hen, goose, and duck, a month; *Query*, of others. The cause of the great difference of times amongst living creatures, is, either from the nature of the kind, or from the constitution of the womb. For the former, those that are longer in coming to their maturity or growth, are longer in the womb; as is chiefly seen in men: and so elephants, which are long in the womb, are long time in coming to their full growth. But in most other kinds, the constitution of the womb, that is, the hardness or dryness thereof, is concurrent with the former cause. For the colt hath about four years of growth; and so the fawn; and so the calf. But whelps, which come to their

growth, commonly, within three quarters of a year, are but nine weeks in the womb. As for birds, as there is less diversity in the time of their bringing forth; so there is less diversity in the time of their growth; most of them coming to their growth within a twelvemonth.

760. Some creatures bring forth many young ones at a burden: as bitches, hares, conies, *etc.* Some ordinarily but one; as women, lionesses, *etc.* This may be caused, either by the quantity of sperm required to the producing one of that kind; which if less be required, may admit greater number; if more, fewer: or by the partitions and cells of the womb, which may sever the sperm.

Experiments in consort touching species visible.

761. There is no doubt, but light by refraction will shew greater, as well as things coloured. For like as a shilling in the bottom of the water will shew greater; so will a candle in a lanthorn, in the bottom of the water. I have heard of a practice, that glow-worms in glasses were put in the water to make the fish come. But I am not yet informed, whether when a diver diveth, having his eyes open, and swimmeth upon his back; whether, I say, he seeth things in the air, greater or less. For it is manifest, that when the eye standeth in the finer medium, and the object is in the grosser, things shew greater; but contrariwise, when the eye is placed in the grosser medium, and the object in the finer, how it worketh I know not.

762. It would be well bolted out, whether great refractions may not be made upon reflexions, as well as upon direct beams. For example, we see, that take an empty bason, put an angel of gold, or what you will into it; then go so far from the bason, till you cannot see the angel, because it is not in a right line; then fill the bason with water, and you shall see it out of its place, because of the reflexion. To proceed therefore, put a looking-glass into a bason of water; I suppose you shall not see the image in a right line, or at equal angles, but aside. I know not

whether this experiment may not be extended so, as you might see the image, and not the glass; which for beauty and strangeness were a fine proof: for then you shall see the image like a spirit in the air. As for example, if there be a cistern or pool of water, you shall place over against it a picture of the devil, or what you will, so as you do not see the water. Then put a looking-glass in the water: now if you can see the devil's picture aside, not seeing the water, it would look like a devil indeed. They have an old tale in Oxford, that Friar Bacon walked between two steeples: which was thought to be done by glasses, when he walked upon the ground.

Experiments in consort touching impulsion and percussion.

763. A WEIGHTY body put into motion is more easily impelled than at first when it resteth. The cause is partly because motion doth discuss the torpor of solid bodies; which, beside their motion of gravity, have in them a natural appetite not to move at all; and partly, because a body that resteth, doth get, by the resistance of the body upon which it resteth, a stronger compression of parts than it hath of itself: and therefore needeth more force to be put in motion. For if a weighty body be pensile, and hang but by a thread, the percussion will make an impulsion very near as easily as if it were already in motion.

764. A BODY over great or over small, will not be thrown so far as a body of a middle size: so that, it seemeth, there must be a commensuration, or proportion between the body moved and the force, to make it move well. The cause is, because to the impulsion there is requisite the force of the body that moveth, and the resistance of the body that is moved: and if the body be too great, it yieldeth too little; and if it be too small, it resisteth too little.

765. IT is common experience, that no weight will press or cut so strong, being laid upon a body, as falling or strucken from above. It may be the air hath some part in furthering the percussion; but the

chief cause I take to be, for that the parts of the body moved have by impulsion, or by the motion of gravity continued, a compression in them, as well downwards, as they have when they are thrown, or shot through the air, forwards. I conceive also, that the quick loss of that motion preventeth the resistance of the body below; and priority of the force always is of great efficacy, as appeareth in infinite instances.

Experiment solitary touching titillation.

766. Tickling is most in the soles of the feet, and under the arm-holes, and on the sides. The cause is the thinness of the skin in those parts, joined with the rareness of being touched there: for all tickling is a light motion of the spirits, which the thinness of the skin, and suddenness and rareness of touch do further: for we see a feather, or a rush, drawn along the lip or cheek, doth tickle; whereas a thing more obtuse, or a touch more hard, doth not. And for suddenness, we see no man can tickle himself: we see also that the palm of the hand, though it hath as thin a skin as the other parts mentioned, yet is not ticklish, because it is accustomed to be touched. Tickling also causeth laughter. The cause may be the emission of the spirits, and so of the breath, by a flight from titillation; for upon tickling we see there is ever a starting or shrinking away of the part to avoid it; and we see also, that if you tickle the nostrils with a feather, or straw, it procureth sneezing; which is a sudden emission of the spirits, that do likewise expel the moisture. And tickling is ever painful, and not well endured.

Experiment solitary touching the scarcity of rain in Egypt.

767. It is strange, that the river of Nilus overflowing, as it doth, the country of Egypt, there should be, nevertheless, little or no rain in that country. The cause must be either in the nature of the water, or in the nature of the air, or of both. In the water, it may be ascribed either unto the long race of the wa-

ter; for swift-running waters vapour not so much as standing waters; or else to the concoction of the water; for waters well concocted vapour not so much as waters raw; no more than waters upon the fire do vapour so much after some time of boiling as at the first. And it is true that the water of Nilus is sweeter than other waters in taste; and it is excellent good for the stone, and hypochondriacal melancholy, which sheweth it is lenifying; and it runneth through a country of a hot climate, and flat, without shade, either of woods or hills, whereby the sun must needs have great power to concoct it. As for the air, from whence I conceive this want of showers cometh chiefly, the cause must be, for that the air is of itself thin and thirsty; and as soon as ever it getteth any moisture from the water, it imbibeth and dissipateth it in the whole body of the air, and suffereth it not to remain in vapour, whereby it might breed rain.

Experiment solitary touching clarification.

768. It hath been touched in the title of percolations, namely, such as are inwards, that the whites of eggs and milk do clarify; and it is certain, that in Egypt they prepare and clarify the water of Nile, by putting it into great jars of stone, and stirring it about with a few stamped almonds, wherewith they also besmear the mouth of the vessel; and so draw it off, after it hath rested some time. It were good to try this clarifying with almonds in new beer, or muste, to hasten and perfect the clarifying.

Experiment solitary touching plants without leaves.

769. There be scarce to be found any vegetables, that have branches and no leaves, except you allow coral for one. But there is also in the desarts of S. Maccaria in Egypt, a plant which is long, leafless, brown of colour, and branched like coral, save that it closeth at the top. This being set in water within a house, spreadeth and displayeth strangely; and the people thereabout have a superstitious belief, that in the labour of women it helpeth to the easy deliverance.

Experiment solitary touching the materials of glass.

770. The crystalline Venice glass is reported to be a mixture in equal portions of stones brought from Pavia by the river Ticinum, and the ashes of a weed, called by the Arabs kal, which is gathered in a desart between Alexandria and Rosetta; and is by the Egyptians used first for fuel; and then they crush the ashes into lumps like a stone, and so sell them to the Venetians for their glass-works.

Experiment solitary touching prohibition of putrefaction, and the long conservation of bodies.

771. It is strange, and well to be noted, how long carcases have continued uncorrupt, and in their former dimensions, as appeareth in the mummies of Egypt; having lasted, as is conceived, some of them, three thousand years. It is true, they find means to draw forth the brains, and to take forth the entrails, which are the parts aptest to corrupt. But that is nothing to the wonder: for we see what a soft and corruptible substance the flesh of all the other parts of the body is. But it should seem, that, according to our observation and axiom in our hundredth experiment, putrefaction, which we conceive to be so natural a period of bodies, is but an accident; and that matter maketh not that haste to corruption that is conceived. And therefore bodies in shining amber, in quicksilver, in balms, whereof we now speak, in wax, in honey, in gums, and, it may be, in conservatories of snow, *etc.* are preserved very long. It need not go for repetition, if we resume again that which we said in the aforesaid experiment concerning annihilation; namely, that if you provide against three causes of putrefaction, bodies will not corrupt: the first is, that the air be excluded, for that undermineth the body, and conspireth with the spirit of the body to dissolve it. The second is, that the body adjacent and ambient be not commaterial, but merely heterogeneal towards the body that is to be preserved; for if nothing can be received by the one, nothing can

issue from the other; such are quicksilver and white amber, to herbs, and flies, and such bodies. The third is, that the body to be preserved be not of that gross that it may corrupt within itself, although no part of it issue into the body adjacent: and therefore it must be rather thin and small, than of bulk. There is a fourth remedy also, which is, that if the body to be preserved be of bulk, as a corpse is, then the body that incloseth it must have a virtue to draw forth, and dry the moisture of the inward body; for else the putrefaction will play within, though nothing issue forth. I remember Livy doth relate, that there were found at a time two coffins of lead in a tomb; whereof the one contained the body of king Numa, it being some four hundred years after his death: and the other, his books of sacred rites and ceremonies, and the discipline of the pontiffs; and that in the coffin that had the body, there was nothing at all to be seen, but a little light cinders about the sides; but in the coffin that had the books, they were found as fresh as if they had been but newly written, being written on parchment, and covered over with watch-candles of wax three or four fold. By this it seemeth that the Romans in Numa's time were not so good embalmers as the Egyptians were; which was the cause that the body was utterly consumed. But I find in Plutarch, and others, that when Augustus Cæsar visited the sepulchre of Alexander the Great in Alexandria, he found the body to keep its dimension; but withal, that notwithstanding all the embalming, which no doubt was of the best, the body was so tender, as Cæsar, touching but the nose of it, defaced it. Which maketh me find it very strange, that the Egyptian mummies should be reported to be as hard as stone-pitch; for I find no difference but one, which indeed may be very material; namely, that the ancient Egyptian mummies were shrowded in a number of folds of linen, besmeared with gums, in manner of sear-cloth, which it doth not appear was practised upon the body of Alexander.

Experiment solitary touching the abundance of nitre in certain sea-shores.

772. Near the castle of Caty, and by the wells of Assan, in the land of Idumæa, a great part of the way you would think the sea were near at hand, though it be a good distance off: and it is nothing but the shining of the nitre upon the sea sands, such abundance of nitre the shores there do put forth.

Experiment solitary touching bodies that are borne up by water.

773. The dead-sea, which vomiteth up bitumen, is of that crassitude, as living bodies bound hand and foot cast into it have been borne up, and not sunk; which sheweth, that all sinking into water is but an over-weight of the body put into the water in respect of the water; so that you may make water so strong and heavy of quicksilver, perhaps, or the like, as may bear up iron; of which I see no use, but imposture. We see also, that all metals, except gold, for the same reason, swim upon quicksilver.

Experiment solitary touching fuel that consumeth little or nothing.

774. It is reported, that at the foot of a hill near the *mare mortuum* there is a black stone, whereof pilgrims make fires, which burneth like a coal, and diminisheth not, but only waxeth brighter and whiter. That it should do so is not strange; for we see iron red-hot burneth, and consumeth not; but the strangeness is, that it should continue any time so: for iron, as soon as it is out of the fire, deadeneth straitways. Certainly it were a thing of great use and profit, if you could find out fuel that would burn hot, and yet last long: neither am I altogether incredulous, but there may be such candles as they say are made of salamander's wool; being a kind of mineral, which whiteneth also in the burning, and consumeth not. The question is this; flame must be made of somewhat, and commonly it is made of some tangible

body which hath weight: but it is not impossible perhaps that it should be made of spirit, or vapour, in a body, which spirit or vapour hath no weight, such as is the matter of *ignis fatuus*. But then you will say, that that vapour also can last but a short time: to that it may be answered, that by the help of oil and wax, and other candle-stuff, the flame may continue, and the wick not burn.

Experiment solitary economical touching cheap fuel.

775. Sea-coal lasts longer than charcoal; and charcoal of roots, being coaled into great pieces, lasts longer than ordinary charcoal. Turf and peat, and cowsheards, are cheap fuels, and last long. Small-coal, or brier-coal, poured upon charcoal, make them last longer. Sedge is a cheap fuel to brew or bake with: the rather because it is good for nothing else. Trial should be made of some mixture of sea-coal with earth or chalk; for if that mixture be, as the sea-coal men use it, privily, to make the bulk of the coal greater, it is deceit; but if it be used purposely, and be made known, it is saving.

Experiment solitary touching the gathering of wind for freshness.

776. It is at this day in use in Gaza, to couch potsherds or vessels of earth in their walls, to gather the wind from the top, and to pass it down in spouts into rooms. It is a device for freshness in great heats: and it is said, there are some rooms in Italy and Spain for freshness, and gathering the winds and air in the heats of summer; but they be but pennings of the winds, and enlarging them again, and making them reverberate, and go round in circles, rather than this device of spouts in the wall.

Experiment solitary touching the trials of airs.

777. There should be used much diligence in the choice of some bodies and places, as it were, for the tasting of air; to discover the wholesomeness or unwholesomeness, as well of seasons, as of the seats of

dwellings. It is certain, that there be some houses wherein confitures and pies will gather mould more than in others. And I am persuaded, that a piece of raw flesh or fish will sooner corrupt in some airs than in others. They be noble experiments that can make this discovery; for they serve for a natural divination of seasons, better than the astronomers can by their figures: and again they teach men where to chuse their dwelling for their better health.

Experiment solitary touching increasing of milk in milch beasts.

778. There is a kind of stone about Bethlehem, which they grind to powder, and put into water, whereof cattle drink, which maketh them give more milk. Surely there should be some better trials made of mixtures of water in ponds for cattle, to make them more milch, or to fatten them, or to keep them from murrain. It may be chalk and nitre are of the best.

Experiment solitary touching sand of the nature of glass.

779. It is reported, that in the valley near the mountain Carmel in Judea there is a sand, which of all other hath most affinity with glass: insomuch as other minerals laid in it turn to a glassy substance without the fire; and again, glass put into it turneth into the mother sand. The thing is very strange, if it be true: and it is likeliest to be caused by some natural furnace or heat in the earth: and yet they do not speak of any eruption of flames. It were good to try in glass-works, whether the crude materials of glass, mingled with glass already made, and remolten, do not facilitate the making of glass with less heat.

Experiment solitary touching the growth of coral.

780. In the sea, upon the south-west of Sicily, much coral is found. It is a submarine plant. It hath no leaves: it brancheth only when it is under water; it is soft, and green of colour; but being brought into the air, it becometh hard and shining

red, as we see. It is said also to have a white berry; but we find it not brought over with the coral. Belike it is cast away as nothing worth: inquire better of it, for the discovery of the nature of the plant.

Experiment solitary touching the gathering of manna.

781. The manna of Calabria is the best, and in most plenty. They gather it from the leaf of the mulberry-tree; but not of such mulberry-trees as grow in the vallies. And manna falleth upon the leaves by night, as other dews do. It should seem, that before those dews come upon trees in the vallies, they dissipate and cannot hold out. It should seem also, the mulberry-leaf itself hath some coagulating virtue, which inspissateth the dew, for that it is not found upon other trees: and we see by the silk-worm, which feedeth upon that leaf, what a dainty smooth juice it hath; and the leaves also, especially of the black mulberry, are somewhat bristly, which may help to preserve the dew. Certainly it were not amiss to observe a little better the dews that fall upon trees, or herbs growing on mountains; for it may be many dews fall, that spend before they come to the vallies. And I suppose, that he that would gather the best May-dew for medicine, should gather it from the hills.

Experiment solitary touching the correcting of wine.

782. It is said they have a manner to prepare their Greek wines, to keep them from fuming and inebriating, by adding some sulphur or allum: whereof the one is unctuous, and the other is astringent. And certain it is, that those two natures do best repress fumes. This experiment should be transferred unto other wine and strong beer, by putting in some like substances while they work; which may make them both to fume less, and to inflame less.

Experiment solitary touching the materials of wild-fire.

783. It is conceived by some, not improbably, that the reason why wild-fires, whereof the principal

ingredient is bitumen, do not quench with water, is, for that the first concretion of bitumen is a mixture of a fiery and watery substance; so is not sulphur. This appeareth, for that in the place near Puteoli, which they call the court of Vulcan, you shall hear under the earth a horrible thundering of fire and water conflicting together; and there break forth also spouts of boiling water. Now that place yieldeth great quantities of bitumen; whereas Ætna and Vesuvius, and the like, which consist upon sulphur, shoot forth smoke, and ashes, and pumice, but no water. It is reported also, that bitumen mingled with lime, and put under water, will make as it were an artificial rock; the substance becometh so hard.

Experiment solitary touching plaister growing as hard as marble.

784. There is a cement, compounded of flour, whites of eggs, and stone powdered, that becometh hard as marble: wherewith Piscina Mirabilis, near Cuma, is said to have the walls plaistered. And it is certain and tried, that the powder of loadstone and flint, by the addition of whites of eggs, and gum-dragon, made into paste, will in a few days harden to the hardness of a stone.

Experiment solitary touching judgment of the cure in some ulcers and hurts.

785. It hath been noted by the antients, that in full or impure bodies, ulcers or hurts in the legs are hard to cure, and in the head more easy. The cause is, for that ulcers or hurts in the legs require desiccation, which by the defluxion of humours to the lower parts is hindered; whereas hurts and ulcers in the head require it not; but contrariwise dryness maketh them more apt to consolidate. And in modern observation, the like difference hath been found between Frenchmen and Englishmen; whereof the one's constitution is more dry, and the other's more moist. And therefore a hurt of the head is harder to cure in a Frenchman, and of the leg in an Englishman.

Experiment solitary touching the healthfulness or unhealthfulness of the southern wind.

786. It hath been noted by the antients, that southern winds, blowing much, without rain, do cause a feverous disposition of the year; but with rain, not. The cause is, for that southern winds do of themselves qualify the air, to be apt to cause fevers; but when showers are joined, they do refrigerate in part, and check the sultry heat of the southern wind. Therefore this holdeth not in the sea-coasts, because the vapour of the sea, without showers, doth refresh.

Experiment solitary touching wounds.

787. It hath been noted by the antients, that wounds which are made with brass heal more easily than wounds made with iron. The cause is, for that brass hath in itself a sanative virtue; and so in the very instant helpeth somewhat: but iron is corrosive, and not sanative. And therefore it were good, that the instruments which are used by chirurgeons about wounds, were rather of brass than iron.

Experiment solitary touching mortification by cold.

788. In the cold countries, when mens noses and ears are mortified, and, as it were, gangrened with cold, if they come to a fire they rot off presently. The cause is, for that the few spirits that remain in those parts, are suddenly drawn forth, and so putrefaction is made complete. But snow put upon them helpeth: for that it preserveth those spirits that remain, till they can revive; and besides, snow hath in it a secret warmth: as the monk proved out of the text; *qui dat nivem sicut lanam, gelu sicut cineres spargit.* Whereby he did infer, that snow did warm like wool, and frost did fret like ashes. Warm water also doth good; because by little and little it openeth the pores, without any sudden working upon the spirits. This experiment may be transferred to the cure of gangrenes, either coming of themselves, or induced by too much applying of opiates; wherein you must beware of dry

heat, and resort to things that are refrigerant, with an inward warmth, and virtue of cherishing.

Experiment solitary touching weight.

789. Weigh iron and *aqua fortis* severally; then dissolve the iron in the *aqua fortis*, and weigh the dissolution; and you shall find it to bear as good weight as the bodies did severally: notwithstanding a good deal of waste by a thick vapour that issueth during the working; which sheweth that the opening of a body doth increase the weight. This was tried once or twice, but I know not whether there were any error in the trial.

Experiment solitary touching the super-natation of bodies.

790. Take of *aqua fortis* two ounces, of quicksilver two drams, for that charge the *aqua fortis* will bear, the dissolution will not bear a flint as big as a nutmeg: yet, no doubt, the encreasing of the weight of water will encrease its power of bearing; as we see brine, when it is salt enough, will bear an egg. And I remember well a physician, that used to give some mineral baths for the gout, *etc.* and the body, when it was put into the bath, could not get down so easily as in ordinary water. But it seemeth the weight of the quicksilver more than the weight of a stone, doth not compense the weight of a stone more than the weight of the *aqua fortis*.

Experiment solitary touching the flying of unequal bodies in the air.

791. Let there be a body of unequal weight, as of wood and lead, or bone and lead, if you throw it from you with the light end forward, it will turn, and the weightier end will recover to be forwards; unless the body be over-long. The cause is, for that the more dense body hath a more violent pressure of the parts from the first impulsion; which is the cause, though heretofore not found out, as hath been often said, of all violent motions: and when the hinder part moveth

swifter, for that it less endureth pressure of parts, than the forward part can make way for it, it must needs be that the body turn over: for, turned, it can more easily draw forward the lighter part. Galilæus noteth it well, that if an open trough wherein water is, be driven faster than the water can follow, the water gathereth upon an heap towards the hinder end, where the motion began, which he supposeth, holding confidently the motion of the earth, to be the cause of the ebbing and flowing of the ocean; because the earth over-runneth the water. Which theory, though it be false, yet the first experiment is true. As for the inequality of the pressure of parts, it appeareth manifestly in this; that if you take a body of stone, or iron, and another of wood, of the same magnitude and shape, and throw them with equal force, you cannot possibly throw the wood so far as the stone or iron.

Experiment solitary touching water, that it may be the medium of sounds.

792. It is certain, as it hath been formerly in part touched, that water may be the medium of sounds. If you dash a stone against a stone in the bottom of the water, it maketh a sound. So a long pole struck upon gravel in the bottom of the water maketh a sound. Nay, if you should think that the sound cometh up by the pole, and not by the water, you shall find that an anchor let down by a rope maketh a sound; and yet the rope is no solid body whereby the sound can ascend.

Experiment solitary of the flight of the spirits upon odious objects.

793. All objects of the senses which are very offensive, do cause the spirits to retire: and upon their flight, the parts are, in some degree, destitute; and so there is induced in them a trepidation and horror. For sounds, we see that the grating of a saw, or any very harsh noise, will set the teeth on edge, and make all the body shiver. For tastes, we see that in the taking of a potion or pills, the head and the neck

shake. For odious smells, the like effect followeth, which is less perceived, because there is a remedy at hand by stopping of the nose; but in horses, that can use no such help, we see the smell of a carrion, especially of a dead horse, maketh them fly away, and take on almost as if they were mad. For feeling, if you come out of the sun suddenly into a shade, there followeth a chilness or shivering in all the body. And even in sight, which hath in effect no odious object, coming into sudden darkness, induceth an offer to shiver.

Experiment solitary touching the super-reflexion of echos.

794. There is in the city of Ticinum in Italy, a church that hath windows only from above: it is in length an hundred feet, in breadth twenty feet, and in heighth near fifty; having a door in the midst. It reporteth the voice twelve or thirteen times, if you stand by the close end-wall over against the door. The echo fadeth, and dieth by little and little, as the echo at Pont-Charenton doth. And the voice soundeth as if it came from above the door. And if you stand at the lower end, or on either side of the door, the echo holdeth; but if you stand in the door, or in the midst just over against the door, not. Note, that all echos sound better against old walls than new; because they are more dry and hollow.

Experiment solitary touching the force of imagination, imitating that of the sense.

795. Those effects which are wrought by the percussion of the sense, and by things in fact, are produced likewise in some degree by the imagination. Therefore if a man see another eat sour or acid things, which set the teeth on edge, this object tainteth the imagination. So that he that seeth the thing done by another, hath his own teeth also set on edge. So if a man see another turn swiftly and long, or if he look upon wheels that turn, himself waxeth turn-sick.

So if a man be upon an high place without rails or good hold, except he be used to it, he is ready to fall: for imagining a fall, it putteth his spirits into the very action of a fall. So many upon the seeing of others bleed, or strangled, or tortured, themselves are ready to faint, as if they bled or were in strife.

Experiment solitary touching preservation of bodies.

796. TAKE a stock-gilly-flower, and tie it gently upon a stick, and put them both into a stoop-glass full of quicksilver, so that the flower be covered: then lay a little weight upon the top of the glass, that may keep the stick down; and look upon them after four or five days; and you shall find the flower fresh, and the stalk harder and less flexible than it was. If you compare it with another flower gathered at the same time, it will be the more manifest. This sheweth, that bodies do preserve excellently in quicksilver; and not preserve only, but by the coldness of the quicksilver indurate; for the freshness of the flower may be merely conservation; which is the more to be observed, because the quicksilver presseth the flower; but the stiffness of the stalk cannot be without induration, from the cold, as it seemeth, of the quicksilver.

Experiment solitary touching the growth or multiplying of metals.

797. IT is reported by some of the antients, that in Cyprus there is a kind of iron, that being cut into little pieces, and put into the ground, if it be well watered, will increase into greater pieces. This is certain, and known of old, that lead will multiply and increase, as hath been seen in old statues of stone which have been put in cellars; the feet of them being bound with leaden bands; where, after a time, there appeared, that the lead did swell; insomuch as it hanged upon the stone like warts.

Experiment solitary touching the drowning of the more base metal in the more precious.

798. I CALL drowning of metals, when that the baser metals is so incorporate with the more rich, as it can by no means be separated again; which is a kind of version, though false: as if silver should be inseparably incorporated with gold; or copper and lead with silver. The antient electrum had in it a fifth of silver to the gold, and made a compound metal, as fit for most uses as gold, and more resplendent, and more qualified in some other properties; but then that was easily separated. This to do privily, or to make the compound pass for the rich metal simple, is an adulteration or counterfeiting: but if it be done avowedly, and without disguising, it may be a great saving of the richer metal. I remember to have heard of a man skilful in metals, that a fifteenth part of silver incorporated with gold will not be recovered by any water of separation, except you put a greater quantity of silver to draw to it the less; which, he said, is the last refuge in separations. But that is a tedious way, which no man, almost, will think on. This should be better inquired; and the quantity of the fifteenth turned to a twentieth; and likewise with some little additional, that may further the intrinsic incorporation. Note, that silver in gold will be detected, by weight, compared with the dimension; but lead in silver, lead being the weightier metal, will not be detected, if you take so much the more silver as will countervail the over-weight of the lead.

Experiment solitary touching fixation of bodies.

799. GOLD is the only substance which hath nothing in it volatile, and yet melteth without much difficulty. The melting sheweth that it is not jejune, or scarce in spirit. So that the fixing of it is not want of spirit to fly out, but the equal spreading of the tangible parts, and the close coacervation of them: whereby they have the less appetite, and no means at all to issue forth. It were good therefore to try,

whether glass remolten do lose any weight? for the parts in glass are evenly spread; but they are not so close as in gold; as we see by the easy admission of light, heat, and cold; and by the smallness of the weight. There be other bodies fixed, which have little or no spirit; so as there is nothing to fly out; as we see in the stuff whereof coppels are made, which they put into furnaces, upon which fire worketh not: so that there are three causes of fixation; the even spreading both of the spirits and tangible parts, the closeness of the tangible parts, and the jejuneness or extreme comminution of spirits: of which three, the two first may be joined with a nature liquefiable, the last not.

Experiment solitary touching the restless nature of things in themselves, and their desire to change.

800. It is a profound contemplation in nature, to consider of the emptiness, as we may call it, or insatisfaction of several bodies, and of their appetite to take in others. Air taketh in lights, and sounds, and smells, and vapours; and it is most manifest, that it doth it with a kind of thirst, as not satisfied with its own former consistence; for else it would never receive them in so suddenly and easily. Water, and all liquors do hastily receive dry and more terrestrial bodies, proportionable: and dry bodies, on the other side, drink in waters and liquors: so that, as it was well said by one of the antients, of earthy and watery substances, one is a glue to another. Parchment, skins, cloth, *etc.* drink in liquors, though themselves be entire bodies, and not comminuted, as sand and ashes, nor apparently porous: metals themselves do receive in readily strong waters; and strong waters likewise do readily pierce into metals and stones: and that strong water will touch upon gold, that will not touch upon silver, and *è converso*. And gold, which seemeth by the weight to be the closest and most solid body, doth greedily drink in quicksilver. And it seemeth, that this reception of other bodies is not violent: for it is many times reciprocal,

and as it were with consent. Of the cause of this, and to what axiom it may be referred, consider attentively; for as for the pretty assertion, that matter is like a common strumpet, that desireth all forms, it is but a wandering notion. Only flame doth not content itself to take in any other body, but either to overcome and turn an other body into itself, as by victory; or itself to die, and go out.

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